INDUSTRIAL PRODUCTION

R. H. L. Lee

THE METHODS AND PRINCIPLES OF INDUSTRIAL PRODUCTION

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THE
Methods and Principles of Industrial Production

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25.10.26

THOMAS NELSON AND SONS, LTD.
LONDON, EDINBURGH, NEW YORK
TORONTO, AND PARIS

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CONTENTS

PREFACE xi

INTRODUCTION xiii

CHAPTER I

SOME INDUSTRIAL PRODUCTS 15

1. A Motor Car.
2. The Human Effort to make the Car.
3. Design.
4. Materials.
5. Manufacturing the Car.
6. A Ship.
7. Shipbuilding.
8. Fitting up the Ship.
9. The Shipping Industry.

CHAPTER II

MORE INDUSTRIAL PRODUCTS 28

1. Artificial Silk.
2. Process of Manufacture.
3. Making the Thread.
4. Sugar.
5. Details of its Manufacture.
6. Sugar Refining and Marketing.
7. Paper.
8. The Fourdrinier Machine.

CHAPTER III

A Typical Factory 38

1. A Motor Car Works.
2. The General Manager.
3. The Works Departments.
4. The Chief Designer and the Buyer.
5. The Accountant and the Storekeeper.
6. The Factory Workers.
7. Main Object in Production.
8. Methods of Production.
9. Final Stages of Production.

CHAPTER IV

General Characteristics of Factories . . 50

1. The Location of Industries.
2. Economic Factors governing Location.
3. The Influence of Labour Supply.
4. Fuel and Power Supplies.
5. The Proximity of Markets.
6. The Supply of Raw Materials.
7. Transportation.
8. Minor Factors.
9. Design, Layout, and Internal Arrangements.

CHAPTER V

History of the Factory System 62

1. Some Early History.
2. The Domestic System.
3. Further Developments in Industry.
4. The Industrial Revolution.

5. Advance of the Industrial Revolution.
6. Results of the Industrial Revolution.
7. Social and Economic Progress.
8. Early Industrial Conditions.
9. Early Abuses in Factories.

CHAPTER VI

THE INDUSTRIAL WORKERS 76

1. General Classifications of Workers.
2. Apprenticeship.
3. The Indenture.
4. Duties and Privileges of Master and Apprentice.
5. An Apprentice's Training.
6. General Industrial Training.
7. Improvers.
8. The Craftsman.
9. The Semi-skilled Worker.
10. The Labourer.

CHAPTER VII

WAGES 90

1. The Wage System.
2. The Calculation of Wages.
3. Wages, Profits, and Losses.
4. Wages by Time Rate.
5. Wages by Piece Work.
6. Advantages and Disadvantages of Piece Work.
7. Modern Systems of Calculating Wages.
8. Premium Bonus Systems.
9. The Halsey or Weir Premium Bonus System.
10. The Rowan Premium Bonus System.

CHAPTER VIII

COLLECTIVE BONUS SYSTEMS: PROFIT SHARING: CO-PARTNERSHIP 109

1. Collective Bonus Systems.
2. The Priestman Bonus System.
3. Co-Partnership or Profit Sharing.
4. Gas Company Co-Partnership.
5. Lever Brothers' System.
6. Co-Partnership in the Coal Industry.
7. Share Holding by Employees.
8. Past and Present Earnings.
9. Money Wages and Real Wages.
10. Family Allowances.

CHAPTER IX

HOURS OF LABOUR: STATE CONTROL OF INDUSTRY 126

1. Hours of Labour.
2. Agreements regarding Working Hours.
3. The Factory Acts.
4. Employers' Liability and Workmen's Compensation.
5. Unemployment.
6. Unemployment Benefits and Insurance.
7. Absenteeism.
8. Restriction of Output or Ca' Canny.
9. Arbitration: The Industrial Court: Whitley Councils: Trade Boards.

CHAPTER X

TRADE UNIONS 142

1. Trade Unions.
2. Individualism and Collective Action.
3. Collective Methods.
4. The Motive of Trade Unionism.
5. The Legal Standing of Trade Unions.

6. Methods of Trade Unions.
7. Stoppages in Industry.
8. Strikes and Lockouts.
9. Development of Strikes.
10. The Economic Loss from Stoppages.

CHAPTER XI

EMPLOYERS : CAPITAL : MANAGEMENT . . . 158
1. Employers.
2. Shareholders and Directors.
3. Joint Stock Capitalism.
4. Employers' Federations.
5. Capital.
6. Administration of Industry.
7. Management.

CHAPTER XII

DETAILED FACTORY ORGANIZATION 170
1. Systematic Organization.
2. Simple Line Organization.
3. Functional Organization.
4. Line and Staff Organization.
5. The Work of F. W. Taylor.
6. The Essentials of Taylorism.
7. Time and Motion Studies.

CHAPTER XIII

PLANNING : PROGRESS : PRODUCTION 184
1. The Planning Department.
2. Duties of the Planning Department.
3. The Instruction Sheet.
4. Rate Fixing.
5. The Progress Department.
6. The Production or Manufacturing Department.
7. The Duties of Foremen.
8. The Foreman's Influence on his Men.

CHAPTER XIV

INSPECTION: STANDARDS: STOREKEEPING: RESEARCH 196

1. The Inspection Department.
2. Standards.
3. Testing a Dimension.
4. Industrial Standardization.
5. Storekeeping.
6. Theory of Storing.
7. Industrial Research.

CHAPTER XV

WELFARE WORK: HYGIENE: MEDICAL SUPERVISION 206

1. Welfare Supervision.
2. Welfare Organization.
3. Welfare Supervision for Boys.
4. Welfare for Women and Girls.
5. Industrial Fatigue.
6. Vocational Guidance.
7. Vocational Selection.
8. Factory Hygiene.
9. Medical Supervision.
10. National Health and Pensions Insurance.

CHAPTER XVI

MODERN INDUSTRY 219

1. The Factory System.
2. Capital and Labour in the Factory System.
3. The Fundamental Industrial Principles.
4. Personal Principles.
5. Division of Labour, Co-operative Effort, and Scientific Method.
6. Tools which replace Manual Skill.
7. Tools which replace Mental Work.
8. The Protection of Mechanical Invention.

INDEX 229

PREFACE

THIS book is intended to explain the principles of industry in an interesting way, not too full of technical details. It deals with elementary things, how commodities are produced, how wages and salaries are earned, and how profits accrue in the long run to those who save money, invest it in factories, and so provide the facilities.

I have tried to preserve a simplicity of treatment, and have excluded theoretical economic discussion. That finds a better place in books on political economy. At the same time subjects which give rise to many violent pseudo-industrial or political arguments could not be excluded. A sincere attempt has been made to state only those facts which have passed beyond the stage of being disputable. It is hoped that readers will find therein a truthful picture of industrial life. Like everyone engaged in it, I am indebted to a multitude for knowledge and ideas. Among those I know I thank Mr. Binney Dibblee for his friendly help.

RICHARD H. L. LEE.

28 Hatton Garden, E.C.1.
March 1927.

INTRODUCTION

THIS book is confined to describing the industrial production mainly carried on in factories, works, quarries, and mines. Those other productive processes, as husbandry, tillage, agriculture, fishing, which provide not only food, but many of the raw materials of industry, are not included. The line of demarcation between agricultural and industrial production serves a useful purpose in studying industry, though it is not always sharply defined, as will be appreciated in a consideration of materials like leather, india-rubber, cotton, wool, or sugar.

Most industrial production now takes place in factories, though there is still a considerable output of home work. Sometimes the latter is on the borderline between industrial production and artistic creation, where again the distinction is not precise. A Luton hat factory turning out thousands of felt or other hats is an example of industrial production, whereas a court milliner producing her "creations" is more akin to professional workers like artists and designers. Nevertheless, her workshop will be supervised by a Factory Inspector. These distinctions must be kept in view to obtain a correct perspective of industrial production.

The nomenclature used in industry has been derived from all kinds of sources; it has grown up, and it is not always precise. Some care must be exercised to ascertain the signification of terms. A simple example will illustrate this. To an engineer planning means pre-

paring precise instructions as to how work is to be done by workmen. In food factories planning may mean the control of the flow of materials and the supervision of output, which functions, in engineering, are called progressing and production supervision, and usually are no concern of the planning department. Hence, in a book largely technical, like the present, words have to be used in their special sense, as is generally indicated in the text.

By derivation, to manufacture means to make by hand, but it has now come to mean making by machine processes where often there is little or no skilled manual assistance. The same word is also used to mean an industry—*e.g.* the woollen manufacture.

The word factory has altered much in its meaning. In the days of the great trading companies it signified a particular trading establishment in a distant country. The East India Company established factories in Calcutta, Canton, and elsewhere for buying and selling, not for making anything. This meaning was connected with factoring, which still means trading as carried on by a middleman. Factory now denotes a building and plant for production. In the Factories and Workshops Acts it also signifies that machine power is installed, while a workshop is a place for production where no power is used. Engineers, however, use the terms works, workshops, machine shops, or simply shops, and seldom call them factories. In other industries various special terms are used, as mill, forge, filature, while manufactory is a clumsy word meaning the same thing.

Industry means a productive art and manufacture, or some particular kind of productive industry—*i.e.* the motor industry. In derivation it is concerned with diligence, the basic virtue of all industrial production.

THE METHODS AND PRINCIPLES OF INDUSTRIAL PRODUCTION

Chapter I

SOME INDUSTRIAL PRODUCTS

I. A MOTOR CAR

A MOTOR CAR is a thoroughly typical example of industrial production. It is interesting and useful, and it appeals to everyone so much that there exists everywhere a big demand for it. Consequently various sources of supply have been called into existence, and a great number, possibly millions of people, now seek an occupation for life in providing a supply to meet the demand. Others find the industry profitable for investing their accumulated savings, that is their capital, thereby providing the means by which the industry can operate. To build the factories, buy materials, pay wages, and meet all the other expenses which arise before the cars can be made or sold, it is essential to have capital. Looked at from another point of view, it appears that a number of capitalists, together with a

number of workers, including managers, engineers, mechanics, clerks, and many others, are all working hand in hand trying to provide for their customers exactly what they require. This is why the industry is so prosperous and successful. The whole group of circumstances is typical of industrial production.

At the first glance a car seems to be a complicated arrangement of innumerable items, but a closer examination soon indicates its different main parts or units, and these again can be subdivided and studied in detail. The first obvious division is (1) the body, which is fixed to (2) the chassis. The body is easily analysed into doors, windows, panels, seats, accessories, and other parts. The chassis will be recognized as comprising a steel frame, axles, and wheels, the engine, radiator, petrol tank, gear box, the driving, steering, and the electric lighting and starting mechanisms, the dashboard with its instruments, and several more units. An ultimate division of the whole car would result in a total of between ten and twenty thousand separate individual parts, each one of which has been manufactured in a definite and precise shape to fit exactly into its place, and perform the function assigned to it. The combination of so many parts made from various raw materials results in a machine which uses a simple natural fuel, and thereby affords most valuable facilities of transport.

2. THE HUMAN EFFORT TO MAKE THE CAR

The prolonged and organized thought and craftsmanship which have designed and wrought this mechanical product begins to be evident. It has not been contrived by mechanical ingenuity and skill alone, but considerable artistic perception has joined in the production.

Upholstery, colouring, and painting are elegant, and could have been perfected only after much thought and research. The craft standard of all the numerous skilled trades which have taken part in the manufacture is on a very high level.

The closer the car is examined the clearer will appear the skill of these trades. Doors and windows, with their latches and fittings, are of greater convenience than those usually found elsewhere. The glazing is practicable ; the driving control remarkably efficient. Precise mechanical engineering plays the largest part in the production, but much sound electrical engineering has been incorporated. A dynamo driven by the engine produces current for lighting and battery charging.

If the motor car owes its existence to the petrol engine, it certainly owes its lightness, speed, strength, and reliability to the new varieties of steel. These all consist of ordinary steel alloyed with a small proportion of one or more rarer metals, as vanadium, nickel, tungsten, or chromium, and they possess remarkable mechanical qualities. Under suitable heat treatment they become very hard, or very tough, or attain extreme tensile strength. Both raw materials and the mechanical units have resulted from prolonged industrial application and ingenuity exercised by many men over a number of years. Their labour and energy, practised under efficient co-ordinating organization in modern works, have built up the modern motor car. It is purely a matter of human effort exerted towards obtaining specific results.

3. DESIGN

An attempt can now be made to classify the various human activities which have co-operated together in a

big modern works, and, by organized and co-ordinated effort, have produced the car. Apart from the financial organization that provided the funds or capital, which, in the first instance, paid for the particular series of efforts that culminated in its production, the first thing to be done was to design the car. It took its form in someone's mind, and was then reduced to paper in drawings and specifications. Like all other progress it is a matter of planning ahead. Every detail had to be set down, drawn and described, and mentally fitted into its place. There is not one single nut and bolt that was not so thought out and specified in size and material by its designer.

The drawing office where such work is carried out is one of the important divisions of a factory. The designers are men possessing previous experience obtained by practice and study. They have to realize the properties of the materials they specify, and they must calculate with precision what exactly will happen when the parts are made and fitted together and begin to function. How great is their skill is proved by the wonderful reliability of the cars now available. The mental power and practical experience as well as the mechanical ingenuity of many men are obtained when a car is purchased. This is what organized industry accomplishes for the whole community. It crystallizes the labour and experience of innumerable workers into standard products, which are offered to the consumers for service at such low prices that very great numbers can be purchased.

4. MATERIALS

The car is manufactured in a works from materials purchased elsewhere. The motor manufacturer does

not make his materials himself in the way that coal is mined in a colliery or iron smelted from its ore at a blast-furnace plant. He is entirely dependent on a steady supply of varied materials which are products of other industries. Many kinds of steel of various grades, each possessing special properties, will be purchased from Sheffield, or other places where steel makers operate. In the car works these materials are manufactured into parts, and the parts assembled into units, which in turn are put together and make up the car. Along with them are incorporated certain articles, such as tyres, glass screens, lamps, and instruments, which have been purchased as finished parts from other factories. It is already evident that what is a finished product in one industry is the raw material of another industry. In no branch of manufacturing is this principle more in evidence than in making motor cars.

In a factory where a complete motor car is produced every few minutes there will be purchased during the year perhaps ten thousand tons of steel, a thousand tons of malleable iron, and hundreds of thousands of small forgings and castings. There will be required acres of plate glass and celluloid, thousands of miles of insulated copper wire, hundreds of tons of paint. All this material will be fabricated into a myriad different shapes. When it first comes into the works, and while it is being used, and again when finally finished in its permanent form, every piece of material must be examined and inspected as to quantity, quality, and accuracy. It has to be taken care of in storerooms, and its reception and storage so carefully adjusted that every single item is ready for incorporation into the cars at the moment it is required.

5. MANUFACTURING THE CAR

In the workshops a motor car is made on the principle of repetition work. This means that not one car at a time is made, but a large batch of them. Mass production is another term used in the same connection, but while all cars are made in numbers, mass production is sometimes intended to mean the manufacture of very large numbers in continuous sequence. This difference, however, is only one of degree. The principle is a very important one in industry. When the car was projected great care was paid so to design each part that it could most readily go through machine tool and other manufacturing processes.

As soon as the working drawings are passed out to the factory, a batch of, say, five hundred cars will be started on. Five hundred each of engines, radiators, petrol tanks, chassis frames, bodies, and all other parts will be commenced. The workers will deal successively with similar parts. By this is meant that those who start on particular operations—for example, turning pistons—will remain on the same job until the batch is put through. The worker when he finishes one item of one car will not go on to an entirely different job on the same car, but will continue doing a similar item for a second, a third, and other cars.

In some examples of mass production this specialization and subdivision of labour is carried to such an intense degree that a man may be employed for years in simply screwing on and tightening up one or two particular nuts on the chassis. A continuous procession of partially finished chassis on a moving platform steadily flows past the particular worker, and as each passes he

will have sufficient time to pick up his nuts, put them in position, and screw them up. By this time another chassis has moved into position for him to carry out the same operation. There is a row of workers all down the long platform, and each has his particular job. In some works experience has shown that less fatigue arises if the moving row of partially completed cars stops for a short period opposite each group of workers to enable them to complete their assembling operation. It is mass production, the cheapest and most efficient way of manufacturing yet devised by man. While the work inevitably tends to monotony, at the same time the rapid output enables the workers to enjoy high wages and short hours.

6. A SHIP

It has been seen that a motor car is usually an example of mass production, which means that a great many examples of a particular pattern of car are produced in a series in the works. A ship is almost always an example of individual production, made to meet special requirements and to a special order. Consequently the variety of ships is much greater than motor cars, since each one, or at most two or three are made to a separate pattern. In common with the motor car and all other engineering products she begins her existence on paper. The naval architect designs the ship after he has been furnished with full particulars of the requirements of her owners. He and his assistants produce the main construction plans, called the sheer draft, comprising the sheer plan which shows the length and height, the half-breadth plan which shows the length and breadth, and the body plan which shows the height and breadth, along

with the subsidiary elevations, plans, and sections which comprise the details of construction. From these the whole work of building the ship is initiated.

The problem of constructing a ship to be strong enough is not a simple matter, and calls forth much constructive ability. At sea she moves across the water which has a very uneven surface. At one moment there may be two waves supporting her, one at the bow and one at the stern, and a hollow amidships. The ship will tend to sink in the middle and break there. Such accidents have happened. At another moment a great wave may support her in the middle like a see-saw and the ends will tend to sink and break off. The longer the ship the more intense will these forces become. To design the frame to support such stresses is the art of the naval architect. At the same time a ship must be so designed to move through water with the least resistance. The power required to drive her, and, therefore, the consumption of coal or fuel oil, will depend on her lines.

7. SHIPBUILDING

First there is prepared a true model of the ship from the drawings and specifications. The laying-down can be commenced simultaneously. The drawings go to the mould loft, a broad, low-pitched room over one hundred yards long, the floor of which is a gigantic drawing board. On this the plans of the ship's members are worked out full size in white chalk, the object being to "fair the ship"—*i.e.* to detect and rectify any error or oversight that may have been made in the small scale plans. Every line necessary to be known in building the hull is here laid down, and checked and counter-checked until it fits exactly and answers all the require-

ments of the design. This is a lengthy process, and from it results the working drawings from which no departure is allowed.

The accurate lines are transferred from the mould loft to the scrive board, which is simply a large drawing board used in the yard. From one or more of these the shipwrights work. A board must be as large as that section of the ship shown in the working drawings, and thus for a large Atlantic liner it will be of considerable size. On the scrive board the plans are marked indelibly; often the different lines are painted different colours to distinguish them.

Near the scrive board in the yard is the bending slab, a pavement of square masses of iron, each weighing many tons, fitted together to form a perfectly level floor. Its dimensions are large enough to lay on it any frame in the ship. Its surface is perforated with peg holes about six inches apart and about one inch diameter, into which iron pegs or dogs can be slipped. The line of dogs inserted will follow as nearly as possible the line of a rib of the ship. As soon as this is prepared the long steel section, previously made red hot, is thrown on the bending slab, and, by pressing it with three pronged forks, it can be bent and made to follow the curve outlined by the dogs.

In this way a rib of the ship can be fashioned to the curvature required, and the corresponding rib on the other side can be bent exactly the same shape. This is the essential process in fashioning the skeleton of a steel ship—it is very different from the method used in building up a wooden ship. A certain allowance is made in the shape of the red-hot steel to allow for contraction on cooling. Ultimately the shape of the bar will be found to be the same as that on the scrive board, which is the

same as that drawn out on the mould loft floor. Before the rib was heated and bent the necessary rivet holes were drilled or punched in it. Afterwards, when the rib is finished for use, cooled, and passed as correct, it is marked with a chisel to show the position of the rib-bands, stringers, deck beams, and plate laps.

The building slip on which the ship will be built and launched has now been prepared in a suitable position alongside the river. On this are laid the flat and vertical keels (the latter is inside a steel ship, but outside a wooden), then the keelsons and the stem and stern blocks. Next the ribs are set up about two feet apart, and soon the familar form of the ship develops itself. After the outer plates have been riveted on the skeleton and caulked, the hull will be water-tight and can be launched.

8. FITTING UP THE SHIP

So far the work has been principally in the hands of the shipwrights, engineers, and boiler makers; but once the ship is floating, an industrial army takes possession. Engineers, smiths, carpenters, joiners, cabinetmakers, electricians, plumbers, riggers, painters, all undertake their separate duties to fit her for sea.

The boilers and engines, or turbines, or the alternative Diesel engines are put in. These are the finished products of a highly organized factory specializing in their production. The shaft will be fitted and the propeller, and the cabins and fittings all finished. The ship will be ready for her maiden voyage, and the industrial army will turn to work on a successor. Continuity of work for all these workers depends on the shipyards receiving a stream of fresh orders from shipowners and merchants.

All the different work carried out by men belonging to various trades is demarcated, and strong trade customs and union rules have gradually been developed to govern which trade undertakes each separate item of work. As with all organization of this character, there has been a tendency to overdo the demarcation and make rules too rigid and inflexible. In fact, it has sometimes been claimed that demarcation was carried to absurd limits. The inevitable tendency was to increase unduly the cost of shipbuilding and ship-repairing. Most of this arose from different sets of workmen being compelled to wait about while other men arrived to do possibly quite small jobs considered to be the privilege of their particular trade. For some time the extra expense thus incurred drove shipowners to transfer their work from British yards to those on the Continent, where such rigid demarcation was unknown. The inevitable reaction occurred, and at the invitation of the shipbuilding employers the trade unions mainly concerned with upholding somewhat old-fashioned rules were invited to amend the position and modify the extremely rigid demarcation which they had so favoured.

Shipbuilding is a form of engineering where the workers are continually called upon to exercise their own inventive genius in effecting improvements in doing the work they have in hand. The nature of the job is essentially different from the closely subdivided and organized duties in the mass production of motor cars. It is, however, the high skill of the British worker which has made British ships, like British cars, unexcelled in the world.

9. THE SHIPPING INDUSTRY

One industry, that of shipbuilding, provides the ships for another British industry of paramount importance, that of shipping itself. This is one form of transportation; railway and motor traffic are others. It is impossible to estimate the great services which the British shipping industry performs for all citizens. On its efficiency depends every industry in the country. Everyone would immediately become worse off if this efficiency declined. Fortunately those who seek their livelihood in shipping are a peculiarly wise and competent group of men.

Perhaps the most important service they render their country is in cheap transportation of food. Grain, for example, is brought from Buenos Ayres to London, more than 6,000 miles, for 12*s.* 6*d.* per ton. To take it by train from London to Northampton, one-hundredth the distance, costs 14*s.* The management of this transport which can convey freight enormous distances across the globe for amazingly small charges is remarkable. Successful ship-owning and management is peculiarly British, and by far the largest part of marine transport over the oceans steams under the red ensign.

The value of the mercantile marine in bringing food and raw material to this island, and carrying away exports of coal or manufactured goods in exchange, is self evident. There is, however, another function of the shipping industry. It is well known that hundreds of British ships are engaged in transporting merchandise and passengers from port to port abroad. For example, many are thus occupied on the China coast, where their customers are Chinese or other merchants. The profits

earned by these ships are really payment for services rendered by British companies and British sailors. They form a most important part of what are termed the invisible exports of the home country, and they materially assist in maintaining the balance of trade.

Chapter II

MORE INDUSTRIAL PRODUCTS

I. ARTIFICIAL SILK

In the earliest days men covered themselves with the skins of wild animals. Later on, still in far-away prehistoric times, fabrics of cotton, linen, wool, and silk were made by spinning and weaving. Although these two processes continue to be carried on by backward people in exactly the same old-fashioned way with the aid of small hand-worked appliances in their own homes, the Industrial Revolution, which began about 1760, caused the civilized western communities to centralize the production in mills. The workman became a machine minder, and the power was derived from the energy in coal or moving water. Wonderful progress was made in applying machinery to spinning, weaving, and driving the mills, and now enormous energy is concentrated upon the infinitely varied problems of clothing the peoples of the world. For 20,000 years every fabric had been woven by hand from threads twisted by fingers. Now machinery makes the material for 10,000 shirts in less time than it took to make enough for one.

Silk is the most luxurious and costly of all textiles, the manufacture of which was developed by the Chinese more than three thousand years ago. It has long been

marked down for either imitation or synthesis. The raw material of silk is the cocoon which the silkworm spins round itself when changing from a caterpillar to a chrysalis. It accomplishes this by eating the leaf of the mulberry tree, composed of cellulose, and converting this into a gummy liquid, which it ejects through two minute orifices in its head. On contact with the air this liquid hardens and forms threads of considerable length and extreme fineness. From these silk filaments all silk fabric is made.

2. PROCESS OF MANUFACTURE

In the past few years there has been accomplished a revolution in the production by artificial means of filaments which resemble real silk. There are several successful methods. The principal one now in use, the Viscose Process, imitates by chemical and mechanical artifices the natural process employed by the silkworm. The foundation material is cellulose, which forms the major portion of all vegetable fibres. That actually chosen is wood cellulose, on account of its plentiful supply and low cost. Spruce trees in the extensive forests in Northern Europe and America are felled, sawn into logs of suitable lengths, and floated down to pulp mills. Here they are dried for some months, the bark stripped and discarded, and the wood cut into chips. In this condition it is digested for several hours, under a pressure from fifty to one hundred pounds per square inch, with a solution of calcium bisulphite. This removes the unwanted constituents such as lignones, gums, and resins.

Almost pure cellulose remains and is freed from calcium bisulphite by extensive washing, is slightly bleached, and

then is made into sheets on a paper-making machine. In this sheet form, having the appearance of a thick piece of blotting paper with a somewhat corrugated surface, wood pulp is exported to both the silk manufacturer and to the high-grade paper maker. It is the true raw material for these industries.

On arrival at the viscose factory the sheets of cellulose are treated in steel tanks with a solution of eighteen per cent. caustic soda. This turns them into sheets of alkali cellulose, which are transferred to a grinding machine able to mill them down to an even flocculent consistency, known as "crumbs." These are next digested with carbon bisulphide in a revolving air-tight container, which results in the production of xanthate of cellulose, an apricot-coloured, lumpy, almost dough-like mass which may be dissolved in water, when it becomes a glutinous fluid known as viscose.

3. MAKING THE THREAD

There follow cleansing and purifying processes, and finally the viscose is fed under pressure to the spinning machines. These imitate the process of the silkworm when he squirts his silk through the orifices in his head. Each spinning machine contains platinum nozzles, possibly eighty-eight of them or more, each of which is perforated by twenty exceedingly fine holes ranged in a circle of half an inch in diameter and corresponding to the desired number of filaments in the ultimate thread. The nozzle is submerged under a coagulating medium in the spinning bath. As the viscose issues from the tiny orifices in the form of continuous streams it reacts with the medium and immediately changes into twenty fila-

ments, and these are collected and twisted. There results a textile thread of great commercial value.

It is now evident that a new thread has been produced artificially to compete with cotton, or linen, or wool, or real silk, the threads of which are all produced from natural filaments. The achievement has been made possible only by remarkable mechanical developments. Success has been attained by a close co-operation between the chemist and the engineer. The latter has designed and made the special plant. Its successful operation in a factory, just as in so many other branches of industry, is largely a matter of knowing how to manipulate the machinery and keep it in perfect working order.

The further processes of weaving the artificial silk thread into fabrics follow lines similar to those invented for other fabrics. Since its cost is approximately one-fifth of the price of real silk in a comparable finished state, and since it can be dyed and woven easily and possesses considerable natural beauty, it has already found highly important uses.

4. SUGAR

At present all sugar comes from natural sources. There is no synthetic sugar made from its chemical elements in some factory equipped with chemical-engineering plant. That may come later on, for synthesis has already been effected on a small scale in the chemical laboratory. But all now consumed is grown, and is a product of agriculture. It comes, say half of it, from the sugar cane cultivated in marshy tropical lands, and the other half from the sugar beet grown in fields in temperate climes. In these two plants the

sugar is made by nature assisted by sunlight. The harvesting of the canes and beet are also agricultural processes, and the products are taken to central factories or controls. The rest is purely a question of machinery.

The industry divides itself naturally into three parts. First comes the manufacture of raw sugar, which generally takes place near by the sources of supply. This is sold and transported to other factories which refine and sterilize it, and these usually are placed in centres where the demand is greatest. Finally the finished sugar is distributed to the grocers, who weigh it out to the public.

When everything is taken into consideration, perhaps the most remarkable quality of sugar is its cheapness. This follows only because of the intensive organization of the industry, and the remarkable mechanical processes used. It is on record that in 1319 a large consignment of sugar was sent from Venice to England in exchange for wool. The value was then 1*s.* 9½*d.* per lb. But at that time money represented so much more than it does to-day, that the present value of this would be over 20*s.* per lb. No wonder sugar was a very limited luxury. Machinery has changed that. The wholesale price in 1840 had been reduced to 48*s.* per cwt. In 1900 this had been quartered, the price then being 11*s.* 6*d.* per cwt. During the war its cost increased, through great beet areas going out of cultivation, but since then there has been a steady reduction in price.

5. DETAILS OF ITS MANUFACTURE

It would take a large-sized volume to contain an adequate description of the machinery and processes used in manufacturing sugar. Consequently a brief

description can only indicate the importance of the development of mechanical means in this industry, as in almost all others. In this respect sugar is only one example of a principle that has been applied to every branch of industry.

The sugar canes are harvested and transported to the control, which is a factory capable of producing raw sugar. Many of these controls are in the tropics, although the machinery is generally of European manufacture. The canes are crushed and the sugar extracted with water, by squeezing and maceration. A modern plant extracts 94 per cent. of the sucrose, and a complete mill requires 1,600 h.p. to drive it. This will crush up to 3,300 tons of cane every 24 hours. Since the canes are only available at the harvest season, it is usual for the mill to work only part of the year. The extracted sucrose is clarified, evaporated, and then crystallized. It now forms the raw sugar of commerce. It is put in sacks and sent to refiners for further preparation.

Raw sugar from the beetroot is prepared in a similar way. The beets are first washed, then sliced up. Sugar is extracted by diffusing, saturating, sulphuring, evaporation, concentration, and curing, all of which simply means that a very complicated machine plant deals with the material through a number of processes until dry raw sugar results.

6. SUGAR REFINING AND MARKETING

The factories which refine are distinct from those which produce the raw sugar, and are usually built near the population which consumes the sugar. Liverpool is a convenient place, and also Silvertown. Ships can bring in the raw sugar from all over the world. Since

harvest time varies from place to place, it will be possible for a refinery to arrange to receive a steady supply throughout the year and keep its machinery continually at work. This is much more advantageous than seasonal working of an expensive plant, and a periodic shutdown. A plant which runs continuously can earn interest and recoup the capital expended at a steady rate, whereas when active production ceases for a time all the maintenance charges keep accruing without earnings being possible. Such a plant working only six months every year is compelled to earn profits more than twice as fast as a similar plant which operates the whole of the twelve months.

Similar considerations will later on in this book be described in connection with short working hours. Any factory which can keep its expensive machine plant running twenty-four hours in a day, the workers taking eight hours shifts, is at a very great economic advantage over a similar factory which operates, say, for only one shift of eight hours in a day. Being at an economic advantage means that higher wages can be paid, and the product should be cheaper.

Briefly, sugar refining consists of melting raw sugar with water into a syrup. This is poured through a filtering cloth to remove sand and other impurities in mechanical suspension, and then through animal charcoal to remove traces of both colouring matter and lime. Finally a perfectly clear white syrup is obtained, cooked on vacuum pans, and crystallized. This is the refined sugar of commerce. The raw sugar whether from cane or beet goes through a similar process of refining, and the resultant sugar is identical whatever its origin.

In English refineries the output of sugar is about half a ton a day for every person employed in the industry.

A moment's thought given to this large output will enable all to realize how great is the assistance rendered by mechanical developments inside the factories.

7. PAPER

Paper-making is the most complete of the inventions of the Chinese. The date given is A.D. 105, and pure rag paper with writing on it of A.D. 150 was discovered in 1907 by Sir Aurel Stein in the Great Wall of China. Chinese prisoners taught the art to the Arabs in Samarkand in the eighth century, and ultimately it reached England about 1500. Most of the supplies continued to come from the Continent until its manufacture, like many other branches of industry, received a great stimulus with the arrival of the Huguenots. England assumed the lead in progress, but has been closely followed by Germany.

Paper-making, at first a hand craft, and in China it still remains so, has been completely changed by the inventions of engineers. The kinds of machines used, and the intimate detail of processes, depend on the type of paper being made. There is a great variety in the finished product, and corresponding differences may be anticipated in processes. But one and all depend on the engineer to construct and keep in order the machines. Only the description of general principles can be attempted here.

Perhaps newsprint is the most interesting product of the industry to-day. For many centuries paper could be produced only in small sheets. They were made by depositing fibrous material on a wire frame or strainer manipulated by the worker. This is a skilled operation, and hand-made paper possesses certain desirable qualities,

so that it is still in demand. Such a thing as a roll of paper in one continuous piece four or five miles long as used on a newspaper press would have been inconceivable to the old-fashioned craftsman working by hand.

8. THE FOURDRINIER MACHINE

The idea of a continuous process of making paper, in place of the old intermittent or discontinuous process, was first carried to a commercial success by a firm of wholesale stationers in London named Fourdrinier. The machine now known as the Fourdrinier machine has probably done more to promote and extend civilization than any other machine. To the uninitiated it is a fascinating sight.

Wood pulp prepared much like that described in Section No. 2, but still in suspension in water, and having the appearance of milk, enters one end, the wet end of the machine. It surges forward on to an endless wire screen which moves like a belt at a speed of perhaps 500 feet a minute. A fibrous film is thus formed. This film passes through the whole length of the machine, winding over and under heated rollers, and gradually losing water, until it emerges at the dry end a continuous roll of paper in a matter of a few minutes after entering. The machine may take over one hundred horse-power to drive it, it may be more than 200 feet long, and it may produce over 150 tons of paper a week. It runs continuously through the 24 hours, from Monday morning to Saturday midday, the working week thus consisting of 132 hours. The workers attend in three shifts of eight hours each.

Such a machine is termed a continuous process machine. It is a far more advanced type of production

than carried out, say, on an ordinary machine tool in the motor factory. There, when one operation is completed, the tool is stopped while a fresh piece of work is exchanged, which then goes through a similar operation. This is intermittent production. Another factor to be noted is that though the Fourdrinier machine is necessarily very costly, yet its product is one of the cheapest known. It is indeed a rule in industry that the cheapest products are usually made in the most advanced and costly factories.

Chapter III

A TYPICAL FACTORY

I. A MOTOR CAR WORKS

A MOTOR CAR is a characteristic product of the modern industrial system, and the works in which it is produced is a centre of organization and activity. A visitor first receives an impression that the processes are of great complexity. Several acres are covered with varied types of buildings, yards, and railway sidings, and thousands of workers appear to be engaged on a remarkable diversity of tasks. The location is perhaps at Coventry or Birmingham, or some other centre where all necessary facilities exist to enable the industry to be carried on.

Convenient transport must be available to bring raw materials, fuel, and general supplies to the works, to convey away manufactured goods, and to provide travelling facilities for the employees. It is essential that the latter may be able to travel to and fro between their homes and the works without delay, for it will be impossible for so large a staff to live close to the works. Quick and cheap transport is necessary, and while trains, trams, or buses provide such facilities, good

roads for those who prefer to cycle or motor are also required.

Often a canal runs close by with basins and wharves. Water transport by barge for bulky materials is cheaper than any other. Factories using large quantities of bulky materials, and of these a paper mill is a good example, are often built on a canal or river bank. An engineering works, however, does not gain much by water transport facilities since the materials used are more suited for rapid conveyance by rail or road, while the finished article can often leave under its own power, or else packed in crates for shipment which can go by rail or road.

The main entrance will lead into a building probably of two or three stories comprising the offices. Adjoining this building will be the works proper with a separate entrance. They consist of one story buildings with a roof of the saw-tooth kind, so arranged to permit a steady north light to enter from above and illuminate the interior. The machine, assembling, and coach-building shops are very spacious. There will be store buildings and yards, with their separate entrances, a power house with a tall chimney shaft, a foundry, and probably a railway siding leading into the works. In many of these general particulars any one works is much like any other.

2. THE GENERAL MANAGER

A visitor will usually go first to the administrative offices, where several different officials and their staffs manage the works. The head of these is the general manager, who controls the whole establishment by means of a suitable organization. His private office will be

comfortably furnished with chairs, perhaps a bookcase or two, and a desk with probably very few papers, but with one or more telephones which connect him with all the departments. He can speak to anyone in the works without delay. He will be kept in constant touch with every activity going on around him. Any question which the head of a department may consider too important to be decided himself can be at once referred to the general manager for decision.

To exercise the control demanded of him requires great reflective power, a broad mental grasp, and a power of quick decision. The general manager will possess all these qualities. By virtue of them he administers the works. Administration is largely a matter of making the organization run smoothly. A great industrial business is conducted not unlike an army. The staff at headquarters does the thinking and planning; the divisional and company commanders, in other words the assistant managers and foremen, translate these orders into actions through the men they control; individual soldier-workers must carry out orders, be loyal, and work in a spirit of co-operation. The general manager devises the means whereby the plans of headquarters' staff are carried into action both quickly and effectively.

The general manager infuses morale into the works; he initiates the spirit of co-operation which must flourish, or the business will not succeed. The better the morale the better an organization will work, the more efficient becomes co-operation. Team-work spirit and goodwill is essential in modern industry. All this flourishes when the general manager is a true captain of industry.

3. THE WORKS DEPARTMENTS

The departmental organization, which is the direct concern of the general manager, comprises several distinct branches, and the principal officials are :

(*a*) The works manager,
(*b*) The chief designer,
(*c*) The head buyer,
(*d*) The accountant,
(*e*) The storekeeper,
(*f*) The welfare officer,

along with others who are in charge of sub-departments.

The works manager is in charge of all the active manufacturing processes carried on in the works, and, next to the general manager, he is the most important official. His staff is by far the largest. His office is situated near the centre of the works, and perhaps a bit away from the other administrative offices. Thus he is readily accessible to the heads of all his sub-departments, his assistant managers, shop superintendents, inspectors, foremen, and others. They can get to him or he can walk to their departments with the least loss of time. He is the responsible head over all the great workshops with their rows of machines, the foundry, the smithy, the heat treatment department, the planning, the inspection, the testing, and probably the storekeeping.

Since the works manager is really at the head of the active production, it will be necessary to examine the branches of work and all the various procedure in his department very thoroughly in the course of this book. Before going further into this, the other officials may be briefly described.

4. THE CHIEF DESIGNER AND THE BUYER

The chief designer is at the head of the drawing office. He is responsible for the design and specification of every detail of the car. As its name indicates, in the drawing office are prepared the working drawings for the factory, as well as specifications of material, processes, inspection, and tests. The chief designer is a leading expert on the internal-combustion engine.

Evidently a designer or draftsman must understand production processes and be fully qualified in the type of industry, mechanical, or electrical, or civil engineering, or whatever else it is. Many industries will not need a drawing office, but in engineering it is of fundamental importance. Indeed it may be a very large department, with a staff of men draftsmen, pupils, girl tracers, typists, and other workers.

The head buyer will purchase everything that has to be bought for the factory : materials, plant, supplies, stationery, and other goods. His staff will not be a very large one, and their main duties will be to keep complete records of quotations and sources of supply, and carry on the necessary correspondence with outside firms regarding inquiries and purchases. The chief buyer is a good business man, cheery and straightforward in his friendliness to everyone. He has many callers to interview on business, and he fills an important position because he carries the whole responsibility for purchasing goods at their proper prices. He must know that goods are of sound quality, correct, and most suitable for use in the works, and be sure of his contractors' capacity to complete delivery at the appointed times.

The correct placing of orders has a very important effect on the success of the factory.

5. THE ACCOUNTANT AND THE STOREKEEPER

The chief accountant has under his charge a staff which devotes its whole attention to keeping accurate and precise records of all the financial transactions in the works. The department will be filled with the paraphernalia of the counting house : ledgers, cash books, card indexes, typewriters, calculating machines. The staff deal with payments out and payments in: the former including salaries and wages, accounts for materials, transport, heat, light, power, rates, taxes, office expenses, and so on ; the latter will be money received for cars sold, or for disposals of scrap or surplus materials.

The general manager looks to the accountant for all information regarding costs of production, which simply means an analysis of money spent, and a comparison of it with the amount of output from the works. Such statistics are of vital importance in exercising control. The matter of profit and loss first comes to light in the figures and balances prepared by the accountant.

The term storekeeper explains itself. He and his staff take complete control of all the stores of materials kept in the storerooms, or yards, or elsewhere in the works. Fresh materials arriving in the works go to him, and until they are required for use they remain in his charge. Other officials always give him a signed requisition before he sends stores into the factory for use in the machine shops or in assembly.

6. THE FACTORY WORKERS

The works manager's staff is very large and includes many different kinds of workers : shop superintendents, inspectors, foremen, machinists, fitters, foundrymen, millwrights, coach-builders, and other tradesmen ; skilled, semi-skilled, and unskilled workers ; apprentices ; clerks,—altogether a varied army, each useful on his own job, and all at work under an embracing control. Their variety and number need thoroughly well organizing. The general plan adopted in an engineering factory is to arrange four main sections under the direction of the works management, and these are sometimes termed the departments of planning, progress, production, and inspection.

The planning department is engaged on deciding how the foremen and workers must actually carry out the numerous manufacturing operations. For every single part in the car, and each process, a proper method is devised and written in detail on an instruction sheet. If an operator is handed material, a drawing of what is required, and the instruction sheet, he should be able to complete the job by his own skill.

The progress department arranges that the different operators, and foremen, and storekeepers, and the different classes of workers, all co-operate with each other. It is a matter of controlling in a systematic way the many parts of the car being made at the same time throughout the factory, and arranging that they progress through all the different manufacturing operations in orderly sequence. Thus waste of time is avoided and efficiency is obtained.

The production section includes the foremen and

operators, all engaged on manufacturing processes, along with the staff of superintendents and works engineers. Every worker is under the charge of a foreman from whom he receives his instructions. The foremen are controlled by a head foreman, or shop superintendent, who will be responsible to the works manager, or one of his assistants. The foremen receive assistance from the officials in the planning and the progress sections.

The inspection department exists to check standards of workmanship, and pass or reject the work done in the workshop. Inspectors determine whether parts and combinations of parts are correct in size, weight, or other quality, and in every way suitable for use. Materials coming into the factory are inspected and finished goods are tested.

7. MAIN OBJECT IN PRODUCTION

The general development of motor-car manufacturing in the early days proceeded along somewhat different lines in different countries. Ultimately the best each country could provide has been appropriated by the others into a common pool. All of them now practise much the same methods. This process of gathering up internationally the best, and abandoning the rest, applies not only to motor cars but runs through industry. Thus newspapers are set up and printed with similar machinery everywhere ; railway locomotives are all much alike ; simple products like calcium carbide, whether made in Norway, America, Switzerland, or Tasmania, result from the same electrical process ; wool is woven into cloth in Yorkshire, France, or Japan by machinery which most probably was made and supplied by the same British engineering makers.

Some of the most intensive processes of manufacturing simple products are carried out in remote parts of the world, and are not to be confined to great cities in the great manufacturing countries. Motor-car production is, however, so complicated a process, employing so many different materials, and trades, and types of men and women, that it has to be practised in an industrial centre, such as Coventry, Birmingham, Derby, Paris, and Detroit.

The mainspring of such production is organization directed towards the definite objects of maintaining and improving the quality of the product, and yet continually saving more time and more labour. The object is to reduce the cost. Organization alone will enable an output to be reached and maintained at sufficient rapidity to control effectively the important question of price. It is not so much a matter of making a good car as it is of making a good car at such a reasonable price that people can buy it. This is one of the fundamental truths in industry. It seems such a truism that it might be taken for granted. Unfortunately manufacturers often overlook it, and examples occur every year of companies which are badly managed in this way, and cause undue loss to their owners.

8. METHODS OF PRODUCTION

With the main object always in view, every detail in the work of production is so designed to further it. Every operation is so timed and arranged that the flow of parts is progressive and continuous. Any breakdown in the link of the chain of production would result in a check. Standardization is adopted as much as it can be to accelerate manufacturing. Machinery is employed

everywhere, often specially designed and only suited for just one purpose, in order that manual work can be assisted. It is often called labour-saving machinery, but it also remains true to call it labour-aiding.

In the early stages component parts are machined from the rough stampings or castings or material in bars. A great deal of this is done on automatic or semi-automatic machine tools. They are set up by a skilled man, and started, when they continue working for long periods without more attention than can be given by a boy, an unskilled man, or, in many cases, a woman operator. Sometimes one person can manage to keep running several machines at the same time.

A striking semi-automatic machine in the workshops is one used to deal with a cylinder block and the upper half of the crankcase, which have been cast in one piece. The main operation consists of boring out the cylinders, valve guides, the holding-down bolt holes for the magneto, the bearer arm holes, and other holes which are in the same plane. All this is done by fitting the piece into a special frame or tool known as a "jig," this being a device which has holes in the right places. By drilling through these holes into the cylinder block the accuracy of the relative positions of all the holes is ensured. The making of jigs, fixtures, and tools is the highest class of mechanical craftsmanship, and with their aid unskilled labour can operate a machine and produce a continuous stream of highly accurate work. This is another illustration of the division of labour.

In the machine shops the whole of the components of the chassis, with a few exceptions, such as the frame, take their form, and then pass to the assembling shops. All the parts are very carefully inspected as they advance from stage to stage of manufacture. The greatest

accuracy is demanded. A certain size for every dimension is determined upon by the designer. However, no man can make anything absolutely exact. What he can do is to make the deviation from standard size very small. The limit of the deviation allowed is called tolerance. A drawing might describe a certain dimension as one inch, plus or minus one-thousandth of an inch. The tolerance would be two-thousandths of an inch, and the limits of size allowed would be 1.001 inch and .999 inch. Any parts made bigger or smaller—*i.e.* outside the limits of tolerance—would be rejected by an inspector. In some cases—a gudgeon pin, for example—a deviation from the correct standard size of one ten-thousandth of an inch is the most permitted.

9. FINAL STAGES OF PRODUCTION

The component parts are put together and built up into units of the car. The high degree of exactness with which they have been manufactured, and the definite limits of accuracy on which the inspectors have insisted, render them interchangeable. This simply means that a number of any one particular part are, for all practical purposes, alike, and they fit other parts without further hand finishing or fitting being required. The men engaged on assembling do not use files or chisels, or even emery paper, to make the parts fit together. That old-fashioned type of fitting work finds no place in modern mass production. Thus the engine will be assembled, and afterwards it will be run quietly, either by electrical driving or else under its own power, to ease the working parts down. Then a bench test for full power will follow, and finally it passes along to be built into the chassis.

The sub-assembly of all the other units has been going on simultaneously, and they are directed into the main stream of assembly where the complete chassis is made up. The body is produced on a similar plan to the chassis. Specialized work, the use of machinery and jigs, both for components and building the frame, paint spraying, and mechanical stoving (hardening paint in a heated oven) of the finished body,—all these things result in greater efficiency, increased output, and reduced cost.

Chapter IV

GENERAL CHARACTERISTICS OF FACTORIES

I. THE LOCATION OF INDUSTRIES

THE many types of manufactured goods met with in everyday life, and it has already been seen how great are the differences between them, are produced in factories which naturally differ very greatly in detail. Nevertheless, certain features about them are governed by general principles, and these may be studied in a preliminary survey under two heads:

(1) Location.

(2) Design, Layout, and Internal Arrangements.

In any country which has reached a high standard of industrial development factories are located according to certain well-defined tendencies. Those that consume large quantities of fuel, such as steel manufacture, will be near the collieries. Others which depend on cheap electricity—aluminium production, for example—must be near natural water power, such as the Falls of Foyers, or the Conway River in Wales, or the Falls of the Rhine. Once an industry has become established in a particular locality there grow up around it influences which assist in maintaining its competitive power against similar industries founded elsewhere at some later date. Thus the English pottery industry is pursued mainly in the

area of the Five Towns in Staffordshire. At first it there enjoyed the advantage of local supplies of raw material and cheap coal. Later it turned to using china clay coming from Cornwall; and there is every reason to think that should the industry change to burning imported fuel oil, brought from some seaport, it will continue to operate profitably in its old locality.

Although it is not always easy to determine why a place should have become associated with its work, nevertheless different localities throughout the world have their own particular industries. Numerous examples will occur to everyone. The making of furniture, pianos, scientific instruments, women's clothes, and printing are a few noteworthy industries in London. A great jute industry exists in Dundee, the raw material coming mainly from India. Silk manufacture is carried on in Lyons and Northern Italy, clock making in the Black Forest, watch making round Geneva, toy production in Nuremberg, and so on indefinitely.

2. ECONOMIC FACTORS GOVERNING LOCATION

The reasons which control the localization of industries may be classed as major factors and minor factors. The major are five in number:

(*a*) Labour supply.
(*b*) Fuel or power supplies.
(*c*) The proximity of markets.
(*d*) The supply of raw materials.
(*e*) Transportation facilities.

The minor factors are more numerous and of special character. Some of them are:

(*f*) A favourable climate.
(*g*) The water supply.

(*h*) Banking facilities and financial considerations.

(*i*) Proximity of manufacturers of the necessary plant.

It will be seen that the selection of a place to establish a new factory is a matter that requires deliberation and reflection. It must be given close economic consideration. In this country no factory will succeed unless it is placed where rigid economy can be practised. The influences controlling the location must in fact be studied in detail.

3. THE INFLUENCE OF LABOUR SUPPLY

The advancement of all industry is largely a matter of the development of the skill of the workers, managers, and technical experts who are engaged in it. Engineering progress too is wrapped up with all manufacturing. Any new factory must depend on a sufficient supply of the workers who will be engaged in it before it can commence operations. It is difficult to induce skilled men to migrate, and it often takes years to establish in a new district an industry which depends on highly skilled workmen. It is said that the pioneer spirit is not strong among them. So the best policy, generally, is to start a new factory not too remote from an area where the labour supply is large and readily available. In fact, a large supply of skilled men tends to give stability and inertia to industry.

On the other hand, there are industries which are little affected by the character of the available labour supply. Factories can then be widely diffused, as occurs in brick-making, cement-making, printing, foundry work, some of which utilize unskilled or semi-skilled workers, while the others require highly skilled assistance. It is easier

to establish a factory which depends only on semi-skilled labour, controlled and directed by a few men with the requisite knowledge. Many large industrial companies, such as Lever Brothers, have started factories throughout the world, wherever sufficient demand exists for soap and candles and their other products.

4. FUEL AND POWER SUPPLIES

Modern industry depends on power. In Great Britain this has been obtained by utilizing the vast supplies of good coal. The heavy manufacturing industries, such as iron and steel, shipbuilding, the hardware trades, cotton, wool, pottery, and others, have been mainly located near the coal-fields. The fact that coal has been abundant and cheap has been the main reason why the industrial life of the country has become so important. Germany and America also have built up their industries on large supplies of coal. It is interesting to note that some of the largest coal-fields in the world, such as those in China, are still undeveloped because of the lack of industrial requirements.

Before coal came to be so much used, water power had some importance, and, to a less degree, power obtained from the wind and from animals. Now again water power, when it can be transformed into electric power, is becoming a very important industrial factor. The abrasive and chemical industries which have been constructed round the Niagara Falls are typical examples, while zinc is being produced on an enormous scale by electrolytic processes in Tasmania. Aluminium is also produced by cheap hydro-electric power in Scotland, Wales, France, Switzerland, and Germany.

Great Britain is deficient in water power since there

are no extensive ranges of mountains, and the rivers are slow and small. In the future, possibly, the tides may be harnessed economically, and then electric power may become cheaper. Meanwhile an extensive and far-reaching development of electric-power supply is taking place under Government control. The great advantage of electric power is that it can be readily transmitted, without undue loss, over very great distances. If arrangements can be made to generate power from coal in the colliery districts, it is hoped to transmit it to other parts of the country, and thus offer to manufacturers and others cheap power. It is hoped to transport electric current cheaper than can coal itself be taken the same distance, and this, coupled with the advantage of producing power on a very large scale, will reduce materially the cost of power. If coal can thus be transformed into power which can be taken over long distances at moderate cost, one result will be that industry will not be compelled to seek its location so close to the coal-fields. Such wider distribution of factories has actually happened in other countries whenever electric power has been generated and transmitted on a large scale.

Some figures are available which show the relative importance of coal and hydro-electric resources as applied to the whole world. The approximate total power production in the world at present is about 120,000,000 h.p., of which factories require 75,000,000 h.p., railways 21,000,000 h.p., shipping 24,000,000 h.p. Of this total amount most is developed by burning coal, some by internal-combustion engines, and 25,000,000 h.p. is developed by hydro-electric plant. Now the total supply of water power is at the least over 400,000,000 h.p., and so the greater portion of the

supplies are as yet untouched. Much of this occurs in remote districts such as north-west India, the Congo, or in central South America. Electric power obtained from water is being transmitted longer and longer distances each year. At present in Southern California it is taken nearly six hundred miles and sold at an economic price. The farther the power can be distributed the greater the value water power in mountainous regions will assume.

The lighter and heavier portions of petroleum have assumed very considerable importance as a source of power. The internal-combustion engine in its many varied forms is a powerful competitor of steam engines and turbines. If coal increases in price, then oil will be assured a greater demand, for it possesses great conveniences, and its use ensures very considerable saving in labour costs. For example, the great Cunard liner *Aquitania* required the services of three hundred and fifty stokers when she burned coal, but with oil firing only eighty-four can do the work. Further, oil is more easily taken on board, it can be stored in tanks in any convenient place, and it requires only two-thirds the tonnage of coal. It is said that the boilers have developed eighteen per cent. more power with oil owing to the regular heat. When oil is not burned under boilers, but is used in internal-combustion engines, a strikingly cheap source of power becomes available. As is well known, progress in the direction is going on rapidly. It should be remembered that the economic importance of the available supplies of oil in the world is very much less than available coal. It is said that so great are the coal supplies that there is more than sufficient to ensure supplies for the next 3,600 years at the present rate of consumption.

5. THE PROXIMITY OF MARKETS

Every industry depends on a market for its existence. Production only happens in order to meet demand. Consequently, when other factors are equal, an industry always tends to develop close to its markets, and it grows with the demand. Many examples exist, one of which, the refining of sugar, was described in Chapter II. There are also such instances as the cement works on the Thames and Medway, near the great market of the metropolitan district. All the London industries have an enormous market ready to hand at the factory doors.

Often an industry, springing up to supply its own market, increases so much in reputation that buyers from elsewhere gather to purchase their requirements. The local demand is thus increased. A striking example exists in the Nuremberg toy trade. Facilities afforded by modern transportation assist in this. At the same time these facilities render it less and less essential for the industry to be confined to a position neighbouring its market, since warehouses and showrooms can take the place of the old factories, and these can then be moved out into the country, where there may be other advantages. The advent of motor transport has greatly helped this process of decentralization.

6. THE SUPPLY OF RAW MATERIALS

Every industry depends on raw materials, some utilizing purely natural products, as coal, iron ore, sugar cane, wood, wool, cotton ; while others buy the finished products of different industries to serve as their raw materials. This was explained in describing the pro-

duction of motor cars. All raw material has its cost steadily increased the farther it has to be moved from its source of origin to where it is utilized. A shipbuilding yard in Southampton will be compelled to pay more for its steel plates and sections than similar yards on the Tyne or Clyde.

This consideration is a very important factor in locating industries. Shipping of bulky raw material makes the problem still worse, and hence the reason for establishing in Newfoundland, near the forests and the source of wood pulp, great paper mills to supply London with newsprint. The economic consideration is the cost of transporting the finished article versus the cost of transporting the bulky raw material. On the other hand, cotton and wool are brought from the ends of the earth to Lancashire and Yorkshire.

The smelting of iron ore in different countries affords an excellent example of the way in which the local availability of raw material is economically balanced against the cost of transportation. There are three raw materials concerned : iron ore itself, coke obtained from bituminous coal, and limestone flux. In Germany fuel from the north is conveyed by rail to the poor Lorraine ore. In the United States rich hæmatite is conveyed hundreds of miles by rail and boat to Pittsburg, near the fuel supply. In England iron ore from Spain can be smelted because sea transport is cheap. An ideal economic situation is attained only when ore, fuel, and flux are found close together, which now seldom occurs.

7. TRANSPORTATION

Easy transportation is important, not only in connection with conveying materials and fuel to the factory

and the finished products away, but also in providing suitable services for the workers and staff employed. The main railways of this country are the natural lines of migration of industries. Road and train transport will enable factories to be taken out of thickly populated areas into the suburbs. It is of great advantage to workers that factories should be distributed more round the outskirts of towns than congregated in the centre, but this can only be done if there is abundant efficient means of transport.

Transportation itself is one of the biggest industries, but it must be regarded as subordinate in importance to production as far as Great Britain is concerned. There are between two and three million men engaged in it. This does not include half a million high seas sailors. Inland transport industry is of that type termed "sheltered"—that is to say, it is not subjected to foreign competition. Its nature precludes this. Hence it is possible for those engaged in it, owners, management, and workers, to arrange for themselves conditions which compare very favourably with those prevailing in "unsheltered" industries, like shipbuilding, or engineering, or agriculture. All the latter are subject to unrestrained external competition in their export trade, and to a less extent at home. In the best interests of the productive industries it is essential that transport should be both cheap and efficient.

8. MINOR FACTORS

Minor factors may also have an important effect on the location of factories. Good banking facilities are one. Modern industry can neither start nor flourish unless backed up by capital, which is now controlled ex-

tensively by the great banks. These can bring together investors and industrialists for their common good. Bank officials too usually study and understand special local industries. If the community happens to be a one-industry type, and then some new industry is started, its originators may be compelled to go outside to get the necessary banking facilities, simply because the local bank officials do not understand the new industry.

A favourable climate has its importance in some manufacturing, as silk weaving, where absence of fog and smoke and abundance of clear sunshine are essential. A good supply of potable water is said to have favoured brewing at Burton-on-Trent, and is a necessity in many chemical businesses.

The big city has its advantages in providing the best amenities of life, as education and amusement, easy transport, a diversified working force, and social advantages, besides offering a market. However, the taxation is usually heavy and the cost of living higher. City sites usually do not lend themselves to expansion, land being too dear. The conditions prevailing in thickly populated areas may not be the most suitable for modern factory work, while trade unions are usually most powerful and wages are higher. Rural sites have both advantages and disadvantages over urban. Housing difficulties are often serious in villages, or in the open country. Suburban regions often offer most of the amenities of city localities and fewer disadvantages. The pros and cons must be carefully balanced before decision is taken.

9. DESIGN, LAYOUT, AND INTERNAL ARRANGEMENTS

The procedure usually followed is that the main details of location, the capacity of the factory, and the main requirements of the departments are settled, and the matter turned over to a professional architect to be elaborated. Some factories are best arranged on a single floor; others have several stories. A fireproof construction is advisable, since it reduces the fire insurance premiums, which is also effected by installing efficient fire-fighting systems.

Factory design requires clear knowledge of all the machinery to be installed, and the processes which are to be carried on. The roof is often a difficult problem. It should be water-tight, not allow moisture to condense on the under side in winter, be fire-proof, and it must not be too expensive.

Internal arrangements, like the general design, form a subject for expert advice. Practically all industry can be divided into two types of continuous and intermittent manufacturing. In the former the raw material goes in at one side, and there is a continuous circulation until the finished product emerges from the other side. Factories for spinning, making paper, bakeries, and many pottery works are of the continuous type. The intermittent type of factory is like those used in making boots, or motor cars; in fact, most engineering works. The components are moved about the factory from one department to another for different processes or for assembling. This kind of work is sometimes known as an "assembling type."

In most works care must be taken that the stores for raw material, and for the reception of finished work, are placed in the most accessible position. Further, the

storerooms and yards are now always planned on a generous scale, as a great advantage is secured when materials can be purchased in large quantities and adequately stored.

In America every worker, on the average, is assisted in his tasks by the provision of 1½ h.p. of mechanical power, and it has been stated that British practice has not been sufficiently generous in this regard. The tendency is to increase the available power, and the service of electricity, provided from some external source, is usually adopted. Sir Robert Hadfield has said that in his Sheffield steel works, where 4,300 men are employed, there is used 12.4 h.p. per man, and of this one-quarter is steam power generated in the works, and three-quarters is electrical power obtained from the Sheffield municipal supply. The big development of electrical power taking place in England should be of great advantage to industry.

Chapter V

HISTORY OF THE FACTORY SYSTEM

I. SOME EARLY HISTORY

It is probable that the Romans were the first to introduce into this country factories of a primitive type wherein manufacturing was organized. Mining and smelting and other industries doubtless existed before that, with owners and workers and capital and an export trade all developed. Previous to the middle of the eighteenth century factories differed fundamentally from the modern type, because the workpeople carried out their tasks by manual labour, utilizing only a limited help from animals, or still more seldom from wind or moving water. Generally it was a matter of the worker doing his work by providing his own muscular driving power for the primitive mechanical apparatus he used. The modern factory is characterized by the wide use it makes of external sources of power.

After the Romans departed the Manorial System sprang up in Britain, and later on there followed the Feudal System. These tended towards personal despotism and were adverse to industry. As the Middle Ages progressed dwellers in towns emancipated themselves from feudalism, and found it to their advantage to associate together into Merchant and Craft Guilds. The importance of the latter grew in the fourteenth

century. The renowned King Edward III. himself went into the city of London and joined the Guild of the Armourers. English industry was beginning its long progress of triumph which has continued down to the present day.

Craft Guilds were constituted as trade societies, composed exclusively of productive members divided into three classes, the masters, the paid assistants or companions, and the apprentices. Apprenticeship began between the ages of twelve and fourteen, and lasted two to five years. The number of apprentices was limited, and in some trades a master could have only one at a time besides his own son. After apprentices had served their time they were promoted to companions, much the same as apprentices to-day become improvers, and they had to remain companions for a definite length of time before they could obtain from the Guild promotion to mastership.

The Guilds, however, outgrew their usefulness. The privileges they had obtained by economic pressure, instead of proving incentives, came to be positive obstacles to trade. Feudalism having now vanished, it became advantageous for craftsmen who wished to get away from conditions approaching industrial slavery in Guilds, to live outside the walled towns. Men at last were free agents whether they lived inside or outside city walls. Factories began to arise, and at the same time there flourished the free Domestic System.

Although there has been a general conspiracy of silence by historians and recorders concerning the ways in which men, freed from feudalism, earned their livelihood, yet now and then some mention is made of organized industry. Edward III. and his queen had much to do with its restoration, especially that of wool,

and the increase of material prosperity which immediately followed. At the beginning of the fifteenth century Jack of Newbury, an interesting character, carried out army-clothing contracts for King Henry VII. He employed over one thousand persons gathered together to manufacture cloth. There were 150 children picking wool, 200 spinners, and he had 200 looms in one room. His was evidently a factory of importance.

A few years earlier the printing industry had been founded by Caxton. Fortunately the advent of books and printed matter coincided with the introduction of paper from the Continent, as described in Chapter II. Without an ample supply of paper the extension of printing and the multiplication of books would have been impossible. The two assisted each other, and the mutual reaction of increased supplies and decreased cost of paper and the extension of printing has continued uninterruptedly until the present day.

2. THE DOMESTIC SYSTEM

Side by side with the early factories there grew up in England, towards the end of the Middle Ages, another type of productive organization known as the Domestic System. This became possible only after the people had freed themselves from feudalism during the fourteenth century. The Domestic System was an organized production for the earning of profits, and it was carried on in home circles. Commodities were produced and sold in the open market by the producers themselves. It was based on independence, and must be carefully distinguished from "home work" done for some outside dominating organization. The latter is simply a form of piece work, and the labour is hired on the same

economic basis as if it worked inside a factory instead of at home.

In the Domestic System the unit was the family and not the corporate society. The labour was free; not slave labour or bound in any form whatever. The master manufacturer was also workman; he was the owner of his instruments of production, the arbiter of his own industrial life. Occasionally the circle would be widened by the admission of strangers; but they were admitted as members of the household, domestic workers with the rest. The cutlery trade of Sheffield, the woollen trade of Yorkshire, the miscellaneous trades of Birmingham, and the cotton trade of Lancashire were founded under such conditions. They were all handicraft industries at first and followed the method of domestic labour.

Very divergent opinions have been expressed respecting the social advantages of this mode of industry. Until quite recent times opinion seemed to be almost unanimously in its favour, and against the factory system. Sentiment perhaps had something to do with it. To-day the tide of opinion flows in the opposite direction. It has been proved that the hygienic and social conditions possible in the modern factory afford advantages which no other method of industrial production could surpass.

3. FURTHER DEVELOPMENTS IN INDUSTRY

As the years went by English industry became of increasing consequence. From time to time workers and industrial processes from the continent of Europe were introduced. In the reign of Elizabeth, Protestant refugees from the Netherlands settled in Lancashire and

elsewhere, manufactured cotton, flax, and wool into fabrics, and added their skill and knowledge to that of their English protectors. The queen herself at one period, deciding to develop some copper mines she owned in Cumberland, on the shores of Derwentwater, introduced a number of skilled German metallurgists. She had to arrange for them to live on an island in the lake, because the local people heartily disliked them and threatened their lives. The Huguenots, it will be remembered, fleeing from the bigotry and persecution of Louis XIV., founded the silk industry in Spitalfields in 1685. There can be no doubt that these movements formed a contributary cause to the steady advance of manufacturing in England, as distinct from the agricultural industry. The latter still continued to remain the foundation of the state's prosperity up to one hundred years ago.

When James I. reigned there were scattered through England no less than 800 metal works, the greater number engaged in making iron. The majority were in Sussex, and most of them were usually engaged on Government contracts for cannon. It is interesting to note that the railings round St. Paul's Cathedral were manufactured by them. Such an industry required definite organization. Capitalists owned it, and the labour was managed and controlled on similar general principles to those in use to-day.

Many more interesting details could be described. A great deal of the growth of English industry was due to the success achieved in woollen manufacturing. Thus it is said that between 1408 and 1486, 300 years before the Industrial Revolution, the fierce competition of English cloth workers reduced the population of Ypres from 80,000 to 6,000 and Bruges from a town

containing 40,000 looms to industrial impotence. There are, in fact, 500 to 600 years of accumulated experience behind the industry and foreign trade of Great Britain.

4. THE INDUSTRIAL REVOLUTION

Thus there existed a Factory System and a Domestic System at the time the Industrial Revolution came. Though dates are not easy to fix, this is usually considered to have commenced about 1760, and to have taken fifty years for its consummation. It rapidly converted the old-fashioned factories into the modern type, where power drives machinery and the workers tend the machines instead of themselves providing the motive force. Furthermore, it almost completely destroyed the Domestic System. It is necessary to acquire a precise idea of this remarkable change, which is probably the greatest achievement ever accomplished by human minds.

Now, as it happened, the very first modern factory in England had been constructed in Derby in 1715. It was an imitation of something that had previously been carried out in Italy, a mill for throwing silk (a process something like spinning), where all the work was done by machinery driven by water power. The operations of manufacture hitherto performed by human hands were here actually performed for the first time in this country by inanimate machinery set in motion by an outside source of power. The workpeople, each quite independent socially, were congregated in one building, and occupied in production about this machinery. It was a development entirely different from the textile factories that had preceded it. That factory derived its power from water, was a striking

advance, and a great economic success. Unfortunately England possesses a very sparse supply of natural water power, and the new type of factory was prevented from making headway. Industry had to wait a few more years until coal burnt under boilers became available as a source of power.

5. ADVANCE OF THE INDUSTRIAL REVOLUTION

The new source of power came from coal when Watt, with his partner Boulton, manufactured steam engines, and offered power for sale.

> "Your Majesty," said Watt to the king, "I sell what all desire—Power."

Although there were many other achievements in that period, this was, perhaps, the greatest of all. Rapid development of the spinning and weaving industries was made possible by the inventions of many mechanical geniuses. There were great improvements in iron production, in transport, and in machinery. In fifty years there was added to the agricultural and village life so great a capacity for manufacturing that England became the workshop of the world.

The Industrial Revolution then was a process which began about 1760, and for convenience' sake is sometimes regarded as lasting fifty, sixty, or seventy years. This is quite arbitrary, for the process has been continuous, and the advance in industrial progress and organization has proceeded with greater and greater acceleration until the present time. It is interesting to note that the descriptive term Industrial Revolution was unknown at the time, but was popularized, if not invented, during the 'eighties by Arnold Toynbee. It has served a useful purpose, although it must always

be remembered that the period is not similar to a sharply defined historical era.

The Industrial Revolution began in Great Britain, and some years elapsed before it spread abroad. The United States began to progress along similar lines after 1850, and Germany followed later on. In these two countries industrialism has been greatly developed. France also has important manufacturing interests, and she has accomplished some notable work in weaving high artistic standards into industry. Italy, Switzerland, and Japan all have modern factory systems. In the British Empire overseas there are indications of future industrial distinction, while the value and variety of production in India have especially increased. Some of the Dominions are favoured in possessing vast water-power resources, where new types of industry are developing without the smoke and slums which the Industrial Revolution has bequeathed to Great Britain.

6. RESULTS OF THE INDUSTRIAL REVOLUTION

The changes wrought by the Industrial Revolution have been fundamental in all that concerns the social and economic relations of individuals and of nations. The resulting mechanical progress has regrouped the countries of the world, and changed every standard of value. In 1750 there were about six million people living in England and Wales under a social system which had developed slowly and haltingly for eight centuries. Now there are forty millions, most of whom depend for their existence on industry and the investment of enormous amounts of capital. So the consequences of the Industrial Revolution have been to render possible a seven-fold increase of population, to

compel most of these people to depend on the investment of capital in industry, while most of the food they eat is imported and paid for with industrial exports.

It is calculated that every man entering industrial life can only do so to-day if someone invests at least one thousand pounds in house, factory, and transport equipment to provide him with means to live and earn his living. The figure is an average estimate taking the population as a whole, and while a smaller sum has been mentioned, we prefer to take the above figure. Now the population of Great Britain which normally enters industry has been increasing at a rate exceeding a quarter of a million annually. This involves the saving and investment of fresh capital by the community amounting to £250,000,000 a year, if the new recruits are to be provided with an industrial livelihood. This problem has very far-reaching ramifications, but the bare statement will indicate its importance and may lead to wonder whether the country can continue to find room for so great an annual increase in population.

7. SOCIAL AND ECONOMIC PROGRESS

Industrial production under all the systems practised since the disappearance of feudalism has been characterized by the complete social independence of the workers. They have not been bound by law or by custom to any particular factory or to any kind of manufacture. They have possessed complete liberty to transfer their labour wherever they wished, to work for whoever desired their services, and to change their employment as often as they would. The social relations established between them and their employers involved quite different considerations from those in

vogue in earlier times, or, for the matter of that, still practised in backward countries.

Now the coming of the Industrial Revolution is often used as a convenient subject for stigmatizing the inherent brutality in human nature, the desire to exploit the ignorant and poor worker. This human failing has been in evidence from the earliest times. The picturesque Athenians preached democracy and practised wholesale slavery. It is a mistake to think that the Industrial Revolution was a step backward in social life, and that before it changed industry so radically the workers were better off, or led a happier life. The balance of evidence is in favour of the view that the Industrial Revolution has caused a marked progress in enabling the humblest workers to enjoy amenities which previously had been denied to the richest classes.

The statement often made that before the days of the Industrial Revolution people lived in comfort on the land is a fallacy. This can be proved by studying the conditions of those communities still living on the land in countries that industry has not yet permeated, as Southern Ireland, Brittany, or Russia, or many others. It is necessary to deny this perverted impression of the Industrial Revolution, even though it is frankly admitted that early factory conditions were very bad before the law improved them. In general, there has been a consistent and steady improvement in social welfare, as well as in factory production. Sometimes one has progressed faster than the other, but the tendency has always been towards improvement, notably accelerated in the present century.

It is probably truer to explain many of the evils that attended early factory organization by the ill-regulated speed with which the system was introduced,

aggravated by foreign wars, a greatly fluctuating demand, and repeated scarcity and dearness of food.

8. EARLY INDUSTRIAL CONDITIONS

It has been fortunate for England that in every age she has had reformers and idealists to lead the people to a better understanding of life, to insist that industry is for the benefit of the people, and that it is wrong to think that people live for the convenience of industry. It is interesting to glance back upon earlier conditions. By Acts of Parliament in 1496–1514, every artificer and labourer had to be at his work during the summer months before 5 a.m., he was allowed half an hour for breakfast and one hour and a half for his dinner, and he was not to leave his work till between 7 and 8 p.m., a working day of over twelve hours. In the six winter months he worked from dawn to evening, artificial light, of course, being unusual and expensive. The working day would average throughout the year over ten hours, and the general conditions of life were miserable and wretched.

Sir Thomas More in *Utopia* satirized these conditions, and, with the object of improving them, he described an ideal country where the workers laboured six hours a day, and had leisure time to devote to pastimes and the pursuit of learning. In his description of the Utopian Commonwealth he anticipated a great deal that has happened in social improvement during the intervening four hundred years.

Consideration of space forbids the pursuit of this subject through the subsequent period down to the time of the Industrial Revolution. A picture of conditions about 1760 is given in the following words of William

Radcliffe, describing the Domestic System at work in Lancashire among the agricultural workers:

> "In 1760 cottage rents, with a convenient loom shop and a small garden attached, were from one and a half to two guineas per annum. The father of a family would earn from eight shillings to half a guinea at his loom; and his sons, if he had one, two, or three alongside him, six or eight shillings per week; but the great sheet anchor of all cottages and small farms was the labour attached to the hand-wheel; and when it is considered that it required six or eight hands to prepare and spin yarn of any of the three materials I have mentioned, sufficient for the consumption of one weaver, this shows clearly the inexhaustible source there was for labour for every person from the age of seven to eighty (who retained their sight and could move their hands) to earn their bread, say from one to three shillings per week, without going to the parish."

9. EARLY ABUSES IN FACTORIES

Before 1760 the south of England was the richer portion of the country, and the north, with so much of its area consisting of barren moorlands and rocky mountainous districts, much poorer. The labouring classes in the north lived in a condition of perpetual hardship. Large-scale manufacturing, introduced by the Industrial Revolution, changed this balance, and it soon became easier to find remunerative work in the factory districts than in the agricultural regions. Migration set in, and population began to increase in the new

centres of wealth. Iron smelting with coke instead of charcoal caused the decay of the Sussex industry, and the rapid increase of blast furnaces near the coal-fields. The labourers went with the industry. Crowds of the most ignorant type gathered to work in the factories, moved by a real get-rich-quick spirit.

It is usual now to hold those early days up to obloquy, but somewhat unjustly. Though painful to look back upon, they must not be judged by the standards of to-day. Leisure was not wanted—was, in fact, unknown. The manufacturer worked with his workers and as hard. Work, work, work was the dominant force years before the time of Thomas Hood. Factory conditions were notoriously bad; elementary sanitary requirements were ignored. The weaker women and children were ruthlessly exploited; they toiled for outrageously long hours in degrading circumstances. The conditions then surrounding industry are to this later humanitarian age almost incredible. The only thing that mattered was the race for the markets of the world.

Perhaps it will now be agreed that no other course was possible at that time. The beginning of every great movement in civilization has had its abuses. They were rampant among the 'forty-niners in California, now one of the fairest centres of human advancement in the world. The early days in Australia and in New Zealand were marked by many excesses. It is as well to be charitable towards the founders of modern industry. Unfortunately, some of the effects of those early days still linger here. The memory of them helps to keep alive a spirit of antagonism to employers, forgetting that it was humanitarian employers who, outraged by the conditions, at length forced the Factory Acts upon industry. Trade unionism owes something of its early

development to the unsatisfactory conditions for workers, although most of its militant activities have been developed long since the prime abuses of the early years of the Industrial Revolution were suppressed. Even to-day in some Oriental countries the condition of the working classes remains much the same as it existed here one hundred years ago. To improve such blots on social progress there has been incorporated into the League of Nations a special department, the International Labour Bureau, and national pressure for improvement is now supplemented by international efforts to persuade all countries to adopt the most approved industrial methods.

Chapter VI

THE INDUSTRIAL WORKERS

I. GENERAL CLASSIFICATIONS OF WORKERS

The Home Office, in its administration of the Factory Acts, classifies industrial workers according to age and sex: men, women, and young persons, the latter being between fourteen and eighteen years old. Children under fourteen are now excluded from industry. In skilled crafts the general division runs according to age: apprentices or learners, improvers, and fully skilled tradesmen. Another important division of men is into the skilled, semi-skilled, and unskilled or labourers. Women are not usually so divided, though they vary in capacity and ability in their particular callings just as much as men.

Now many industries no longer depend on the exercise of any special degree of manual skill, and those engaged in them cannot possibly be classified according to their ability and dexterity. A tendency steadily increases to classify these workers according to the nature of the work they do. Consider for a moment the distinction between one man who plays a piano and a second who cannot, but is able to operate a pianola. The first is a craftsman with special skill; the second need be no more than semi-skilled or unskilled. In craft ability there is a wide gap between them. The

same kind of distinction exists in industry. A tool-maker in an engineering factory is a highly skilled man ; both his fingers and his mind have been patiently trained. On the other hand, a railway signalman of the average type uses his mental powers mainly, if not entirely, according to a pre-arranged routine, while his manual dexterity consists of pulling and releasing a few levers. In comparison he can best be described as semi-skilled.

Nearly all industrial workers can be divided into these two broad types. A minority possess definite craft skill acquired by long training as apprentices or learners, and perfected by practical experience. They nearly always possess a fairly wide knowledge of operations and processes in their particular trade. Industries like engineering, printing, saddlery, and harness-making, and all high-class crafts like musical instrument or furniture making, book binding, building, include a large proportion of skilled craftsmen. The semi-skilled type of men are numerous. They may be machine-minders who will feed into a machine some raw material, manipulate the mechanism by simple controls as levers, valves, handwheels, press buttons, switches, and then will withdraw the resulting product produced by the machine under their attention. A smaller proportion of workers are completely unskilled, and possess economic value simply by reason of their muscular power in doing work in which machinery has no part.

2. APPRENTICESHIP

Apprenticeship is an ancient system. It was an integral part of the Craft Guilds, and in a statute of 1562 it was made the law of the land that no one should

exercise a trade unless he had been apprenticed for seven years. The position enjoyed by apprentices was of considerable prestige: they were, for example, an active political party in London. This old statute was not repealed until 1814, and since then it has been lawful for every person to exercise any occupation or calling of a mechanical or trading character for which he deems himself qualified. Formerly apprenticeship was a compulsory contract; later it became a voluntary one. Undoubtedly this has hastened a decay of the system, and now there are trades, especially where machinery has replaced skilled craftsmen, in which apprentices are unknown. In other trades such as printing, engineering, and shipbuilding, apprenticeship, or a period passed as a learner, is still the rule.

Many trade unions recognize apprenticeship, and have made rules and working arrangements with employers to control it, but on the whole they do little to protect and preserve the system. There is a National Institute of Apprenticeship which is active. In continental countries the apprentice system still flourishes, but in America it has become obsolete, and little account is taken of indentures or serving time to a trade. At the same time it is curious to note that the skilled English craftsman who has learnt his trade thoroughly by means of apprenticeship is in great demand in American factories. For some years past there has been a steady emigration to the United States by more highly-skilled British workers, who have thus been lost to home industry.

3. THE INDENTURE

The indenture is the usual legal instrument or document agreed between the master and the apprentice,

or usually the latter's relations, guardians, or friends. Any written agreement properly expressed, attested, and stamped will do as well. There is a tendency to regard the age of fifteen to sixteen as the most suitable for being indentured. A period of five years has proved sufficient for an ordinary lad to learn a highly-skilled trade. Some firms prefer to give a boy a previous trial extending over a few months, during which both sides can satisfy themselves that he is suited for the trade, and the indenture is afterwards dated back to include this.

In the indenture or articles of apprenticeship there is set out the full consideration of the bargain, together with the amount of the premium, if any. It is usual to outline the scheme of wage payments to be made to the apprentice. The indenture must be correctly stamped.

Once made, the contract can only be dissolved according to one of the following methods :

(*a*) By the passing of the stipulated time.

(*b*) By death of the master, or of a partner in the employing firm, or of the apprentice. If the apprentice dies the part of the premium corresponding to the unexpired period of apprenticeship is not returned, but if the master dies the apprentice is entitled to claim it.

(*c*) By mutual consent.

(*d*) In case of grave misconduct.

(*e*) By bankruptcy, under which proportional repayment of premium can be claimed.

4. DUTIES AND PRIVILEGES OF MASTER AND APPRENTICE

The indenture or agreement is kept by the master and handed to the apprentice when he has served his time

and the conditions have been fulfilled. Any man who has the legal capacity to make a contract may take an apprentice, nor does the law limit the number a single master may take. Such limitations do exist to-day, just as they did with the old Craft Guilds, but they are the result of bargains made between trade unions and employers. Thus the builders' unions have restricted greatly the number of apprentices, and there has been a tendency among printers to do this. However, in 1926 the President of the Federation of Master Printers of Great Britain uttered a warning to his fellow employers that they were not taking as many apprentices as they were allowed under the agreements with the trade unions, and he considered the position so serious that in the future there would not be sufficient craftsmen to carry on the industry.

Nowadays the apprentice no longer lives with his master as in the Middle Ages. The master must teach him the trade. A master may not assign an indenture to any other master without the approval of all parties to it. Further, he is not allowed to make any deductions in the apprentice's wages should he be ill or meet with an accident unless such right is entered in the indenture.

It must be remembered that the consent of the apprentice has been definitely obtained by his executing the indenture, and any person over seven years of age of legal capacity can bind himself as an apprentice. Execution by the apprentice is essential. He is not bound to work on Sunday, but he may be required to work on Bank holidays, and otherwise his hours are governed by the modern Factory Acts. He may not enlist in the Army, Navy, or Air Force without making suitable arrangements with his master in the matter of his indentures, and should he so enlist his master may

reclaim him, if under twenty-one, although he must again return to the Army, Navy, or Air Force for service when he comes out of his time. An apprentice is included under the term workman in the Workman's Compensation Act of 1906.

The apprentice is in duty and by law bound to give good service to his master, to be of good conduct, and to carry out diligently all that is set out in the indenture. He is liable to be punished by a magistrate if he fails to do so. In the City of London there still continues a remnant of the practices of olden days. Apprentices are subject specially to the jurisdiction of the Chamberlain of London. They enjoy peculiar privileges, such as admittance to the Freedom of the City, an honour greatly esteemed.

5. AN APPRENTICE'S TRAINING

An apprentice has his training so arranged that most of the time he is working under commercial conditions and considerations. Things are made in the factory for sale, and in their production the apprentice takes his share. Hence he is in a different position from a student at a secondary school or college. The teaching and training which it is desirable that every capable apprentice should receive cannot be arranged with such facility as in a college where output has no place. Nevertheless, with the shorter working hours in vogue, and the facilities for obtaining first-class instruction in evening classes and polytechnics, there is no longer any excuse for an apprentice not advancing himself in his trade. Many masters pay great attention to teaching their own apprentices inside the works during working hours.

An apprentice's course of training should be defined by a responsible official of the firm, and not left to be settled from time to time by foremen, or shop superintendents, or by any official whose main duty it is to obtain a satisfactory output. The fourth and fifth years of an apprentice's training are the most important, and the instruction and supervision at that period should be as thorough as the factory executive can arrange. The training of apprentices in one British works, where over 300 have been indentured at one time, and where no other boys are employed, has led the works director of that establishment to formulate a series of six axioms to apply to a suitable system of training :

(*a*) The apprentice must be always busy.
(*b*) The apprentice must be always learning.
(*c*) Engineering being an exact science, the apprentice must develop the scientific mind.
(*d*) The apprentice's course of training must not be determined by the shop foreman or manager responsible for output.
(*e*) There cannot be too many highly-trained apprentices.
(*f*) Special training must be given to those apprentices who show marked ability.

6. GENERAL INDUSTRIAL TRAINING

Both formal apprenticeship and the payment of a premium in return for being taught a trade are slowly but surely going out of use. In very few trades is it now enforced, although some still retain it, such as printing, especially in London ; the Thames watermen ; to a less extent the saddlers and harness makers and many small crafts. In part it continues to exist in nearly

all the skilled crafts ; hence it still retains considerable industrial importance. It almost always ensures acceptance of a man as a fully skilled member of a craft trade union, and this has its value. What, however, is taking the place of the formal apprenticeship is an informal service contract, or, more often than not, a verbal contract, neither of these being legally binding or enforceable. Whether under these conditions a learner develops into a fully skilled craftsman, or simply becomes a semi-skilled worker, is largely determined by his own ability, industry, and perseverance, and to a considerable degree perhaps by the opportunity or lack of opportunity which presents itself.

Conditions controlling industry in this second quarter of the twentieth century are appreciably changed. They grow more onerous ; subdivision of labour increases ; the semi-skilled worker is in greater demand than the skilled ; the latter has suffered an unfortunate setback in his prestige and capacity to earn larger and steadier wages, because of the determined pressure brought to bear by the industrial unions ; employers are now chary of entering into any industrial contracts which will bind their liberty of action for several years ahead. There has followed upon these and many more causes the growing practice for boys to enter factories to do all kinds of odd jobs. Then the best of them become learners ; they gradually "pick up" their knowledge, and acquire their skill as best they can. The few who are clever and industrious and show aptitude succeed in entering the ranks of the skilled men ; most of them become semi-skilled and remain in that category all their lives. The lazy and incompetent remain labourers.

7. IMPROVERS

An apprentice just out of his time is not considered a fully skilled craftsman, although he should be qualified rapidly to become one. He lacks the necessary experience to accept full responsibility. Often he seeks independent work and accepts a lower wage than that of a fully skilled man, in order to get skilled work to do, and so improve his experience and general all-round knowledge. He is known as an improver. His promotion to full rate of pay, or on to remunerative work, now depends greatly on his own industry and capacity. His future is in his own hands, and to a promising youth promotion is usually not long delayed.

Owing to the growing disuse of a long period of apprenticeship, and the increasing vogue of employing boys as learners without any agreement, it is becoming customary for youths of eighteen to be regarded as improvers. All these youths, whether indentured or not, should be offered every possible inducement to attend a proper course of evening tuition at one of the centres now abundantly provided. Quite apart from it being of advantage to the boy to do so, it is also in the best interests of industry. Both high-grade workmanship and scientific administration in factories will be perfected only if the younger generation of workers is constantly improving in its industrial standards.

8. THE CRAFTSMAN

The fully skilled man, craftsman, tradesman, or journeyman, is the most important of the industrial workers. Having passed through a long training at a nominal wage as an apprentice or learner, and then

probably worked as an improver for two or three years, he has reached the stage when he knows his trade thoroughly and can be relied upon to carry out work which requires both intelligence and manual skill. Such a man has always been a valued citizen of his country, and there is no reason for thinking that the prestige he derives from his usefulness will be diminished.

In recent years the trade unions of the skilled men, organized by craft and not by industry, have suffered a setback by reason of the greater numbers of workers, most of them semi-skilled or labourers, who have been organized into the large industrial unions. By sheer pressure of numbers both employers and craftsmen have had to agree to the anomaly of the semi-skilled receiving a wage equal or greater than that paid to many skilled men. This condition of affairs, by reason of its manifest unfairness, is not likely to be permanent.

It is from the ranks of the skilled men that industry normally recruits its foremen, shop managers, and higher permanent officials possessing practical knowledge, and engaged in active management. The opportunity for promotion out of the ranks of the workers is one of the greatest inducements to become a skilled craftsman.

9. THE SEMI-SKILLED WORKER

Semi-skilled work has already been described in a general way. It includes the trades and the manufacturing processes which do not require a long period of teaching, training, and industrious application to learn. They can nearly all be acquired in a comparatively short period, but they are distinguished from purely unskilled labouring work by requiring some moderate standard of intelligence and knowledge. The

following practical definition was given before a Royal Commission by Sir Benjamin Browne:

> "The semi-skilled man is a man who works a machine, or does something of that sort, like a man who strikes for a blacksmith. He is a man who would not have to serve an apprenticeship, but has picked up a certain amount of special skill which makes him worth more than his neighbour for the special work. In that class is included coal miners, navvies, and all those men."

Regarding their training, the term "picking up" their knowledge is convenient and expressive. This class of workman is the most numerous in industry. It has been divided by one authority into four sections:

(1) Special process men who possess a narrow range of considerable skill. Usually they operate machine processes. A boot and shoe maker in a factory on one of the machines is a good example, but the boot maker who can deal throughout with any bespoke order for hand-made boots is, on the other hand, a highly skilled craftsman.

(2) Workers who have learned part of a trade, such as navvies, painters' brush hands, guillotine cutters, and so on. This is the largest class of all among workers.

(3) Men who carry out work of considerable personal responsibility, requiring great care and trustworthiness, but little or no skill, such as scaffolders, stokers, cranemen.

(4) The mates or assistants to craftsmen, of whom the plumber's mate is a classical example.

Every kind of wholesale machine production in factories demands a large supply of semi-skilled workers.

Boys often go straight on to a man's job of this type when they reach eighteen years of age, and some of them earn a man's wage on piece work. The constant application of fool-proof machine devices to industry, as well as the increasing subdivision of labour, favour an increase of semi-skilled men.

10. THE LABOURER

There is left for consideration the class of labourers. It would be difficult to place a definite dividing line between the semi-skilled and the unskilled, but perhaps the latter may best be taken to comprise all those who possess a minimum of skill and knowledge, and who have neither received nor required even a short training. Such knowledge as distinguishes a good from a poor labourer has been acquired purely by practice. To mention a few of the callings into which the labourer drifts, there are the municipal scavengers, road sweepers, dustmen, coal heavers, dock labourers, and so on. Between them they bear most of the burden of sheer muscular work required by civilized communities. Formerly they were badly paid, but recently, with the increased vogue of subsistence and minimum rates of pay, and the ameliorating conditions which have come about partially by an improved public conscience, and partially by the economic pressure of the trade unions into which these men have been collected by astute industrial organizers, they now enjoy reasonably good wages and shorter hours. In fact, in many cases their standard is higher than that of skilled men in highly competitive trades. An investigation will often show that many unskilled industrial workers have come

straight from the class of agricultural labourers, a calling much worse paid, but which, in comparison, requires a much higher grade of skill.

Before leaving the subject of skilled, semi-skilled, and unskilled labourers, it is well to indicate that these divisions are of a general nature and do not fit precisely every kind of worker. Among a group of men engaged in craft work it is not always easy to classify them. The semi-skilled especially are now able to obtain membership in many craft trade unions previously denied them. Efforts have been made to determine more scientific classifications of industrial work, and of those efforts the following brief division into four types possesses some interest :

(*a*) Automatic manual labour.
(*b*) Responsible manual labour.
(*c*) Automatic brain labour.
(*d*) Responsible brain labour.

Some tasks require only one type of work, others require two or more.

Fundamentally the fact remains that babies are born unequally endowed, their later opportunities and efforts always differ, and no two men are ever found equal in ability or in attributes. Of the industrial workers one small group can be counted skilled, a large group partially skilled, and another smaller group unskilled. Very few indeed are absolutely unskilled, and of the classes this is probably the one least justified by its description. There is, too, a strong tendency for the dividing line between skilled men and semi-skilled men to be obliterated. The division has hitherto been preserved mainly by the policy of the craft unions in asserting that no man could move from one grade into a higher.

Abroad the practice has always been that a man could leave, say agricultural work, at any age and start as a Grade III. worker. Then if he was clever enough, ability and not training being the deciding factor, he could work his way up into Grades II. and I. On the other hand, if by reason of apprenticeship he started life in Grade I., then he might be reduced to Grade II. or even to Grade III. if he proved incompetent. This is a more reasonable attitude than restricting all men to the grades in which they start their industrial lives. Ability should always be the deciding factor : prohibition of promotion for the competent worker has too long been a black spot in the policy of the English craft unions.

Finally, one other consideration may be emphasized. It is in the best interest of the community that the number of absolutely unskilled labourers should be kept as low as possible, by the encouragement of education and by other inducements. This class tends to drift often by the sheer economic competitive pressure of their numbers into casual occupation, perhaps working only one or two days a week, and they and their families are liable to be compelled to eke a living on the very borderland of subsistence or of poverty. The slightest additional pressure of bad times in trade and they are driven to have recourse to poor relief—that is, the rest of the community are compelled to provide by charity sufficient means to enable them to exist. The evils of casual labour in the past have been intense, but there is a growing tendency to try and eradicate them from the economic system.

Chapter VII

WAGES

I. THE WAGE SYSTEM

Workers in industry are usually paid a weekly wage. In some instances they are recompensed partially in kind. Miners are given weekly a certain weight of coal fixed by custom. Free meals may be provided; house-room at a reduced rent, or even rent and rate free; sometimes uniforms are provided. But the normal case is to pay wages in money on Friday or Saturday. The amount earned may be determined by time—so much an hour, a day, a week, a month, or a year. Or it may be determined entirely by the quantity of work accomplished, which is piece work or contract work. These are the two primary methods of paying workers, either by time or by piece. Frequently pay is calculated by a mixture of both time and piece, and there are many varied combinations of the two fundamental methods by which wage and salary payments are finally made up.

The wage system has come to us from ancient times, but it still remains the fundamental issue between those who employ and those who are employed. It is founded on the worker's point of view, which thus may be expressed:

> "We work to receive regular wages, on which we rely for our living. We refuse to accept any risks

incidental to the business. If profits accrue after our wages are paid, the employer is welcome to keep them; but if there are losses, the employer must alone bear them."

The standing of the worker is expressed in legal phraseology by:

"Wages are a first charge on industry."

What actually happens is that the proceeds of the industry are divided, subject to the employer guaranteeing to the worker that he will get the first share.

In working for wages on this basis the worker inevitably subordinates himself to the interests of capital. One of the social movements of the time is that directed to introduce a practical restraint to prevent unfair domination. So far it has been a matter of the balance of power between organizations of workers and owners. This has not given satisfactory results in all disputes, and better methods will have to be devised.

2. THE CALCULATION OF WAGES

Now the wages problem is always a matter of deciding how large a share of the proceeds of industry the worker can have. Every worker is entitled to receive a payment commensurate with the value of the work he does: no more and no less. This, however, really takes the matter very little further, because the question at once arises—who is the party qualified to fix the valuation? Is it to be done by the employer alone, or by consultation between the worker and the employer, or by a third disinterested party? Furthermore, so interdependent has national life become, it is now doubtful if there is

any member of a state wholly disinterested in the amount of wages paid to any section of workers.

Whatever the actual amount paid, it is calculated by referring to the two primary methods of reward, by time or by piece. Formerly the time unit was frequently taken as a day, and payment by time is still referred to as " day work " even if the unit is the hour. The word journeyman, meaning craftsman, is derived from *journee*, a day, the unit period for which formerly he was paid. A very large number of workers prefer to accept work on an hourly basis. The man is subject to a dismissal notice of one hour, and must give the same length of notice to determine his engagement. Others work by the week, and must give a week's notice to their employers before quitting their jobs.

It is often convenient to pay per unit of time without immediate reference to the actual achievements hour by hour, or day by day. For example, a tram driver has to keep up a certain rate of work, and is usually paid a weekly wage. But in other cases the man himself can influence materially the amount of work he does, and it may be desirable to pay on a piece rate, or according to results—in other words, by some process of valuing and measuring his efforts. In such cases any engagement between the two parties ends when the work it was agreed to do is completed.

3. WAGES, PROFITS, AND LOSSES

Before proceeding any further, it is necessary to emphasize the essential distinction between wages and profits. They are two entirely different things, and bear very little relation to one another. Wages are paid in return for work or effort. They are the first

charge upon an undertaking. Originally provided out of someone's capital investment, they are later on provided by the continual return and re-spending of this capital in the course of production. Thus the capital circulates round and round in a successful business enterprise.

The original investment, though it provides wages, *never* provides any profit. To enforce this truth it has been made absolutely illegal for company directors to declare dividends out of capital. The way profits arise is that as the capital circulates it increases from a number of causes. This increase is the profit, and when capital is invested it is always with a definite hope that it will so increase. After the circulation of capital, and long after all wage charges and other expenses have been met, then there accrues the profit. While wages are a first charge upon an undertaking, profits are no charge at all, but appear only after every charge or liability has been met. The great virtue of profits is that they induce capitalists to invest their savings and thus create industry. Without security for their capital, or a chance of obtaining a profit out of the investment, men with money would not invest it in industrial ventures. They would prefer to hoard their wealth under their own control, just as the people of India or China do, because they fear to lose their savings. Instead of investing their money, or putting it in a bank, it is put in a hole in the ground.

Profits, then, are made up of the increment to capital which results after it goes through repeated cycles of being spent on manufacturing and recovered from sales of the product. Usually it is that part of the total capital invested in an enterprise known as the working capital which circulates in these repeated cycles, and

its increment is the profit on the whole capital, which may be a much greater amount. If more money comes in than goes out there is a profit, but if less comes in there accrues a loss. The consideration of losses throws further light on the total disconnection between wages and profits. A practical example will make this clear.

Some years before the war the Wolseley Motor Car Company was inaugurated, and proved highly successful. Its profits were substantial from 1909 to 1914, and in the latter year it succeeded in earning no less than 30 per cent. on its Ordinary Capital. Then came the war, when it was compelled to manufacture what the Government required. It still succeeded in making small profits for four years, and these were retained in reserve and not divided among the shareholders. When the war was over it possessed a reserve of £300,000, and it turned once more to motor-car production, for which it had earned a world-wide reputation. The financial results for the succeeding years were as follows:

1920	loss of	£83,582
1921	,,	£97,030
1922	,,	£77,621
1923	,,	£327,263
1924	,,	£324,843
1925	,,	£189,055
1926 (first nine months)	,,	£133,000

By November 1926 it had reached so unfortunate a position that it was unable to pay its debts for raw materials, and a Judge of the Court of Chancery ordered a compulsory liquidation. Thus was lost £1,000,000 of ordinary capital, £300,000 of preference capital, and a great part of £1,700,000 of debenture stock. It paid no

dividends on its ordinary capital after 1914, no dividend on its preference capital after 1920, and no debenture-stock interest after March 1926. Those who had invested their money lost it.

At the time of the order for liquidation the company employed 3,000 men, and had, in previous years, employed many more. All these employees, whatever their positions, had received their full wages and salaries for the services they had rendered. The financial losses were borne alone by the shareholders ; employees cannot share these losses. As long as a risk of losing capital is involved in industrial ventures so must the economic distinction between wages and profits be emphasized, for the risk justifies owners taking high profits as a counterbalancing factor without incurring obligations to share them with those recompensed by wage or salary.

In normal times there is some relation between wages and profits, inasmuch as wages generally are increased when the profits increase. An ideal state of affairs will be reached, and this ideal is practicable, when industry will be working at its highest attainable efficiency, from which all will benefit. This depends on four essentials, which are usually found combined where real success is achieved :

(1) High wages.
(2) High profits.
(3) High production.
(4) Low prices.

It seems paradoxical that lowering the price of an article may increase wages and profits, but this is repeatedly done. The explanation of this paradox falls within the domain of economic theory, and it will suffice to add here that the problem for the producer is to

determine such a cost of production for his goods that will enable him to obtain his most effective market.

Some employers have proved by practical efforts that goodwill among their workers is improved by making arrangements to share some of the profit between the owners, who have the sole legal right to it, and the workers, who have already received their wages. This becomes purely a matter of ameliorating the asperities of industrial life, or as it is sometimes described, a concession to industrial psychology. It in no way affects the truth that wages and profits are two entirely distinct economic entities. Some employers frankly admit that sharing profits with their workers results in increasing the profits to share simply from the favourable reaction following the concession. Various methods by which this is accomplished are described in a succeeding chapter.

4. WAGES BY TIME RATE

It is a very natural convention that a wage should be regularly paid according to the passage of time. Living expenses, rent, rates, and taxes all steadily fall due for payment as the weeks and months pass. To meet them a regular and reliable wage is a satisfactory arrangement. The system has the merit of simplicity. It assumes that the employee will offer loyalty and fair service in exchange for his regular wage. When supervision is adequate and the worker is reliable this fair exchange is secured. The time rate too is the most suitable way of paying for general services, such as the wide variety of duties performed by a sailor or farm hand. In such occupations it is often difficult to define precisely the hours to be worked.

Time rates of payment influence the mentality of

different men in different ways. Many are thoroughly satisfied when they have agreed with an employer to receive a certain rate of wage or salary, and can put the matter of remuneration out of their minds while they turn their whole energies to their work. Others, on the contrary, are inclined to balance their earnings against their own potential capacity to earn more. They may not be satisfied to remain at a standstill in life. Still other men require the stimulus of a possibility of immediately increasing their pay in order to encourage them to put forward their best efforts.

As factories get larger and the number of men increases, some of one temperament and some of another, and the work itself gets more subdivided and specialized, the defects of day work become more pronounced. Those who are naturally inclined to idle find scope for avoiding supervision and allowing others to bear the burden. The men who must have external stimulus to work hard slacken their efforts unconsciously. In fact, the operation of time payment or day work has been proved in practice to offer too little inducement to the body of workers to do their best. It is both unfair to good men who could increase their earnings if paid by results, and it is unfair that the inferior worker should obtain a rate of pay uniform with the better man when he does not deserve it. Again it is unfair to an employer that he should be compelled to pay a uniform standard rate of wages whatever the output. So it has been decided that a time rate of payment is unsatisfactory to both employer and employee whenever a system can be devised to pay by results.

5. WAGES BY PIECE WORK

When a manufacturer quotes a price for an article, he offers a definite commodity for a definite amount of money. He in turn, when making the article, would like to be certain that he always obtains a definite amount of work done in his factory for a fixed payment to his workpeople. A simple example will suffice to explain the idea. A cigarette manufacturer sells his cigarettes to retailers at 4*s.* a hundred. Out of this the tobacco and paper cost him, say, 2*s.* 6*d.* a hundred, the miscellaneous expenses, such as rent, rates and taxes, insurance, heating, lighting and power, administration, and all the rest of what are termed overhead expenses, cost him say another 9*d.*, and he wishes to have a profit of 3*d.* a hundred. This leaves him 6*d.* to allow for labour costs, and if he can arrange with his workers that for every sixpence he pays them they will manufacture 100 cigarettes he has fixed up a piece-work arrangement and is secure from loss. If he were to pay the workers a fixed hourly wage, and for some reason or other they were to produce cigarettes at a slower rate, he would lose money; but by arranging the work on a piece-work basis he secures himself from loss. Furthermore it is important to note, the faster the worker learns by practice and efficiency to operate, the greater his own remuneration becomes. This appears more satisfactory to both employer and worker than ordinary time payment. Some workers, such as the compositors on the London daily papers, dislike working in any other way than by piece work, and their earnings are on a very high level.

In factories piece work is very frequently applied.

Straight piece work, as described above, implies no guarantee of any hourly or weekly rate of wages. The piece price is fixed for a definite number of pieces, and no other consideration enters into the bargain. When the job is finished the contract is automatically determined. A fresh contract has to be agreed to either at the same piece price, or some modification of price and task.

A fresh factor was introduced when the idea of minimum day rates came to be agreed between trade unions and employers' federations. In engineering, for example, when a piece rate is fixed there is always the proviso in the bargain that the worker is guaranteed the hourly trade-union rate whether his piece-work earnings are greater or less. If greater, he pockets the extra amount; if less, the employer pays him the day rate and loses on the piece-work bargain. In other words, in industries where a minimum rate is enforced this must be paid regardless of earnings on piece work. Another interesting thing about piece work in engineering is that the trade union expects the employer to so fix the prices that a reasonably good worker can earn time and a third.

While highly satisfactory in many cases, yet piece work begins to show defects when work of a high degree of accuracy is required, and where the tools and machinery are costly. Some processes are inherently unsuitable for piece work, such as tool-setting and repairing, or where defects or variation in the properties of materials cause wide variations in the time taken on a task.

6. ADVANTAGES AND DISADVANTAGES OF PIECE WORK

A brief consideration will show the advantages of piece work. There is always a much higher concentra-

tion on the part of the worker. There has been transferred to the worker the same responsibility of doing a definite amount of work for a definite payment as the employer carries in all his contracts with his customers. If the worker's output is large and his earnings are high, this brings a special advantage to the employer, who has to pay the same rent, rates, taxes, and other overhead expenses whether the hourly output is high or low. The higher the output the smaller the percentage of oncost to be included in the manufacturing cost of each article. This leads, possibly, to a larger margin of profit, which, in turn, allows of a reduction in price to the consumer when this is desirable. So high output, lower factory cost, higher profits, and a cheaper article for the consumer are possibilities which arise when the workers' efforts are increased by the stimulus of piece work.

There are possible disadvantages. The first arises over fixing the piece-work price. The greatest care is required to ensure that it is a fair price to both employer and worker. If too high a price is given on a particular job, the man will earn a very high increase over the standard rate, not so much by reason of his own ability as by the fact that someone fixed a wrong price. This causes dissatisfaction among other workers who may not have been so fortunate. To prevent this the man may hide the fact that the price is too generous by going slow, thus preventing the good output which the piece work was designed to obtain. The question of fixing the price, in fact, often degenerates into a war of the men's wits against the management. The men gauge their speed on what will produce time and a third. Then the management inclines towards cutting the rate when it is obvious that the advantage is too heavily

on the side of the workers. The latter retaliates by ca' canny, a trade trick which will be explained later in Chapter IX., Section 8. It leads to a demoralizing position.

The practice of rate-cutting, which is reducing the piece-work price after it has been fixed, has a very bad reputation in industry. It is generally assumed by the workers that it is done by the greedy employer to swell his profits. There have been well authenticated instances of this, but in the great majority of cases it follows inevitably from the free competition in industry. One factory may introduce piece work on certain processes, and the men earn high wages through their hard work, while the employer will obtain high profits and the business be very successful. This incites competition. Some other manufacturer will introduce a somewhat similar piece-work system with lower prices. Workers are found to operate at the lower level, and thereby the second manufacturer can cut the selling prices of the first. The inevitable result will be to reduce piece-work prices all round. The position will be forced by free competition. It is this element which is ultimately the deciding factor, and not the individual rapacity of employers. Nevertheless, whatever the reasons may be, the practice of rate-cutting forms the greatest objection to the system of payment by piece work.

7. MODERN SYSTEMS OF CALCULATING WAGES

During the last forty years various new wage systems have been devised and operated, and while some of these, on a first acquaintance, appear somewhat complex, a careful analysis will always show them nothing more than combinations of the two fundamental methods.

What the inventors have always had in mind is to retain most of the advantages of both time and piece rates, and to do away with the disadvantages. It is generally agreed that the best systems actually do accomplish this difficult task. Yet as each new system has been put into operation its relative advantages and disadvantages have caused prolonged disputes. The policy of many of the trade unions is to prefer uniform day wages, the good and the mediocre workers all receiving the same rate of pay. It is unnecessary here to indicate that this is not a fair arrangement for those who are cleverer and work harder. To enable industry to benefit from the more industrious workers, at the same time increasing their earnings, bonus systems have been adopted on a very large scale. Since so many hundreds of thousands of workers are now thus paid, it is desirable to study the leading systems in detail.

The systems can be classed as :

(*a*) Premium Bonus Systems. Of these the Halsey or Weir, and Rowan are the two of most importance. Many of the largest and most prosperous manufacturing enterprises have used these for years. The Harrington Emerson is another used in America.

(*b*) Collective Bonus Systems. The Priestman system is well known, and there are others in use where more complicated factors are used.

(*c*) Sliding Scale Wage Systems.

(*d*) Co-partnership and Profit-sharing Schemes.

The most important of these will now be described in more detail.

8. PREMIUM BONUS SYSTEMS

All these have a common starting-point. They agree that a definite day-work rate, which is usually the local trade-union rate, shall be paid. The worker is thus guaranteed that he will receive for every hour's work the rate of pay which has been fixed by agreement between his trade union and the employers' association. This precludes the trade unions from logically opposing the system, since the workman cannot receive less than the union rate of pay for the time he spends in the factory. This portion of a worker's total remuneration is termed "the wage." In addition he is also offered "a premium bonus." The amount of this bonus depends on the actual time the worker takes to complete his work, and the quicker he is the greater the bonus. To him is held out the inducement to earn not only his wage, but to have added a substantial bonus by being diligent and industrious.

A standard time is fixed in which each process or job can be completed by a normal man working at a normal rate. When the work is given to the man he is told the standard time fixed. For example, he might have to assemble twelve motor-car engines, and the standard time allowed him might be six hours each, total seventy-two hours. If he completed the job in, say, eighty hours he would be a slow worker, but he would receive full trade-union rates for the period, which would be, if his day rate was 1*s.* 3*d.* per hour, 80 × 1*s.* 3*d.* equals £5. If he took seventy-two hours he would receive 72 × 1*s.* 3*d.* equals £4, 10*s.* But supposing by diligence, and making full use of his past experience, he took only sixty hours to complete the

work. His wage for that time would be 60 × 1*s.* 3*d.* equals £3, 15*s.* In addition, since he has improved on standard time, he will be paid a bonus. The bonus might be 10*s.* Thus he will receive a wage of £3, 15*s.* plus a premium bonus of 10*s.*, total £4, 5*s.*, for only sixty hours' work; an average payment of 1*s.* 5*d.* per hour. In this way he has made himself a more highly paid worker than he would be if on day work at the trade-union rate.

Thus a premium bonus system is seen to be a combination of payment by time (day work) with a new idea, that the more diligently a man works the more shall he be paid. In every kind of premium bonus system the time a worker takes for each separate process or job is recorded in comparison with the standard time allowed. In piece work the essential idea is that each job is worth so much money, and it follows that the faster a man works the more he earns. In premium bonus systems the fundamental idea is that each job should be done in a standard time, and it is arranged that the faster a man works the larger the bonus he earns. Thus there is a connection between piece work and premium bonus systems. There is also an important difference. In piece work the worker receives a fixed payment whatever the time he takes. In premium bonus the remuneration increases as the time is reduced.

9. THE HALSEY OR WEIR PREMIUM BONUS SYSTEM

The first premium bonus systems were devised in England, but it is not clear how they originated. Their first definite association is with Mr. Halsey, who introduced an organized plan into Canadian factories in 1890. Under it the men were guaranteed the customary day

rate. Then standard times were fixed by a special department in the factory and inserted on all instruction cards issued to operators. It was agreed that a premium bonus would be earned in every case when the time taken was less than the standard time. The time saved was noted and the premium reckoned at a value of, say, one-third to one-half of the value of the time saved, the fraction varying from one factory to another. In America it is said one-third is usual ; in Great Britain one-half is usual. This latter is accepted in the Weir premium bonus system, which otherwise resembles the Halsey system.

As an example, suppose the day rate is one shilling per hour, ten hours the standard time allowed for a definite job, and the premium bonus payable is one-half the value of the time saved. If a man takes, say, twelve hours, he receives 12*s.* and no bonus—*i.e.* 1*s.* an hour. If he takes ten hours he receives 10*s.* and no bonus—*i.e.* 1*s.* an hour. But if he does it in six hours he gets 6*s.*, plus one-half of the value of the time saved—*i.e.* half 4*s.* equals 2*s.* Altogether, then, he is paid 8*s.*, which works out at 1*s.* 4*d.* per hour.

It will be seen that the system is quite simple. It is, therefore, easily understood by all workers. The premium is easily computed and payments checked. It recognizes the principle of increased pay for increased effort, which is the basic principle of piece work, but it will be noted that the man does not get such largely increased earnings as he would do on straight piece work. In the above example, if the standard time is ten hours at 1*s.* per hour, the corresponding value of the work in a piece-work system would be 10*s.* If the man did it in six hours and received the full 10*s.* he would be earning 1*s.* 8*d.* an hour, whereas under the

Weir premium bonus system he received only 1*s.* 4*d.* Of course there is the counterbalancing advantage that if he took twelve hours he would receive 12*s.*, since he is guaranteed 1*s.* an hour, and not 10*s.* as in straight piece work. In connection with this it must be remembered that in engineering there is always a time rate guaranteed in Great Britain, even where men are working on straight piece work, but this does not apply in some other industries.

The Weir system, as it is widely known in Great Britain, from the name of the founder of the Weir engineering works at Cathcart on the Clyde, has been operated for many years past in a number of works with great success. It is regarded as possessing a conciliatory character, and therefore is helpful to the workers. Most premium bonus systems follow the Weir plan, or the Rowan plan, which will next be described.

10. THE ROWAN PREMIUM BONUS SYSTEM

The authors of this modification of the Weir system were Mr. James Rowan and Sir William Rowan Thomson, partners in the Glasgow marine engineering works of David Rowan & Company. They introduced it in 1898, it has been in continuous use since, and it is completely successful. It starts by guaranteeing the usual fundamental day rate. Then standard times are fixed. It is a saving in this time which is desired. Now the premium bonus in the Weir system is a fixed fraction of the value of the time saved, usually one-half. In the Rowan system the premium is obtained by multiplying the time saved by a factor which is not fixed, but variable. This is the fundamental difference between the two

systems. The following formula shows the method of calculation.

$$\text{Premium} = \text{Time saved} \times \frac{\text{Time taken.}}{\text{Time allowed.}}$$

Another way of expressing this is that the amount of premium bears the same relation to the ordinary wages due for the time actually taken as the time saved bears to the full time allowed. For workshop use in simple language it becomes :

If he saves a quarter of the time, he is paid time and a quarter.

If he saves a half of the time, he is paid time and a half.

If he saves three-quarters of the time, he is paid time and three-quarters.

This last way of expressing the rule shows that a man can never earn quite double wages under the Rowan system. With the Weir system, as soon as he saves two-thirds of the standard time his actual earnings are doubled. This is one important difference between the two methods. Therefore, if a mistake should have been made originally in fixing the standard time too high—and such things do happen—the workman cannot use this mistake to obtain large earnings under the Rowan system as he could in the Weir system. He can do it, too, in ordinary piece work when the piece price is fixed too high. Consequently the Rowan system eliminates one source of dissatisfaction in the workshop, since men who are getting moderate wages do not like to see one of their number earning considerably more through someone's mistake.

It might be asked at this point, what happens if a

mistake of the other kind is made when fixing the standard time, and the workmen cannot earn a bonus? This can easily be remedied in practice by extending the standard time. The authors stated a rule for time setting: "the time which *should* be taken for the job when working at day rates." Once a standard time is set it is always possible to increase it, but it is quite another matter to decrease it, or, as it is termed, cut the rate. The latter action has a very bad reputation.

So, in practice, the Rowan system is relatively insensible to errors of rate-setting, and any inaccuracy is minimized in its effects by the nature of the formula. This, the authors claim, practically eliminates any temptation to cut rates, and should offer strong moral support to the average employer always faced with market competition. It is also claimed that the staff of any average engineering works should be able to set the rates with sufficient precision to prevent more than a 50 per cent. of time saved becoming a practical possibility. In practice half the men in Rowan's works make 40 per cent. premium every year. The system is claimed to suit trades where accurate rate-setting is difficult and would require an expensive staff, and where work of a varied character is undertaken, rather than a factory where a very large proportion of intensive repetition work is found. The system then is especially suited to middle cases, the average factory, the average workman, and the average staff.

Chapter VIII

COLLECTIVE BONUS SYSTEMS: PROFIT SHARING: CO-PARTNERSHIP

I. COLLECTIVE BONUS SYSTEMS

THE premium bonus systems described in the last chapter are suitable for workers engaged on independent jobs. For stimulating and spurring on the individual to do his best they are very successful. They are applied with greater difficulty to groups of men working together. Although one of them, the Rowan Scheme, has been used in squad work, yet, as a general rule, they cannot be extended to include all productive work of this character. In industry so much has to be carried out by two or more men working together as a team or gang that great importance is attached to including such joint work in the scope of payment by results, without always relying on piece-work contracts. A bonus calculated and paid on their combined output is desired.

A collective bonus system, as distinct from a premium bonus system, may be defined as a method of calculating the value of results so that an allowance, or reward, or bonus, is paid to everyone over and above his regular wage. It is calculated and paid as a result of extra effort on the part of a group of workers as a whole. The group may be a small one or may include everyone in the factory. Reference has to be made to some standard

performance for calculating the bonus, and this must always be paid as a separate entity from wages. It has been thought desirable to fix the standard performance so that good workers, obviously working diligently, should be able to earn a bonus of at least 25 per cent. over their ordinary wages.

2. THE PRIESTMAN BONUS SYSTEM

In 1917 the engineering firm of Priestman Brothers, Ltd., of Hull, wishing to extend output for war purposes, decided to introduce a bonus system, and this has since become the best known method in the country. Most of their work was not so suitable to a premium bonus system as that usually carried out in the Weir and Rowan factories, and it was desirable to include the whole of their workers under one all-embracing scheme.

The first step was to determine and fix a fair standard of output. Various ways by which this could be calculated were considered, and finally one was adopted which converted the weight of finished articles to a certain value in points. In fixing these points every possible factor was duly taken into account. Both the manufacturing and the repair work were so treated, and every boy and man engaged by the firm was ultimately included in the system.

At the end of every month the actual work completed is ascertained and the prescribed system of points allotted to it. Comparison with standard output fixes the bonus to be paid to everyone. The weekly wage of every employee during the succeeding four weeks is then increased by the amount of this bonus. At the end of that time another bonus rate has been determined. Should by chance the output in any month fall below

the fair standard output, the deficiency is carried forward and deducted in due course from a subsequent surplus.

The Priestman Bonus System has received a good deal of praise and has met with considerable success. It is a scheme based on collectivism while premium bonus systems are individualist, and the fashion is to favour collectivism. There is no doubt it finds itself best placed in a well-organized works where a fairly uniform output can be maintained. It is attractive to average workers rather than for those with special ability who are anxious to make the most of their skill and opportunities. One interesting point should be noted : this system increases the pay to the worker in direct proportion to the increase of output, just as occurs in straight piece work. Hence some trade-union officials, who do not like the premium bonus, have expressed a partiality for the Priestman System.

3. CO-PARTNERSHIP OR PROFIT SHARING

So essential is it in industry to secure the whole-hearted co-operation of all employees that many leaders of industry have advocated systems of sharing profits or co-partnership. The profits accruing to the owners, who possess the sole legal right to them, are shared with the employees. This is the guiding principle, though the details may be arranged in many different ways. The object is to encourage the workers to put forth their best efforts and to suppress any latent design to limit the output, or ca' canny as it is often termed. It is thought that a system which ensures a distribution fair to both parties will make the workers realize that their own share depends almost entirely on their own efforts. The natural consequence will be that they will strive

to do their best, the profits will thereby increase, and not only will they benefit, but actually the owners in the long run will gain.

Many advocates of profit sharing claim that very beneficial results have already been secured in definite instances they are able to quote. It is, of course, not easy to arrange an equitable scheme. The main difficulty appears to arise from the fact that workers like to receive their returns quickly from any increased efforts put forth, whereas profit sharing generally means waiting until profits are declared at the end of the year. A still greater drawback occurs when at the end of the year it is found that through bad trade, or some external competition more than usually severe, or some other reason, there are little or no profits to share. Employees, of course, may share profits but they cannot share losses.

The result of these diverse conditions is that in a few notable instances here and there profit-sharing schemes have been very successful. To the greater proportion of industrial undertakings they are inapplicable. In fact, it cannot be said yet that this idea has done much to ameliorate or modify the old wage system for the great majority of workers. The extra remuneration has never been nor could it become more than a small proportion of the worker's earnings. It is rather interesting to observe that though a profit-sharing scheme must mean only one thing, and that is the worker is given the same chance as is possessed by his employer to obtain an increased remuneration, and therefore it might be expected to appeal to him, yet many official trade-union leaders are opposed to the idea. The reason vouchsafed for this opposition is that successful profit-sharing schemes undermine the strength of trade unions, an explanation which is somewhat inadequate. An official representa-

tive of the Railwaymen's Union at the Oxford Meeting of the British Association in 1926 stated frankly that "the unions regarded all co-operative schemes as suspicious, because they had as their main object the retention of an economic system which the labour element regarded as hostile to its interests. Further, if any co-operative scheme did come in it must not be confined to a share in profits, but a direct share in the management must be given the workers." To this attitude of mind it may be replied that most co-partnership schemes have caused a better feeling between employers and employed, which is exactly what they have been created to do.

4. GAS COMPANY CO-PARTNERSHIP

The late Sir George Livesey, who was head of the South Metropolitan Gas Company in London, was the author of a real co-partnership scheme. First introduced in 1889, it has been one of the continuously successful social experiments in industry. One reason for this is that there exist special conditions in the gas business, and another is that it was well conceived. The scheme is one of the few existing examples of a real and complete industrial co-partnership.

The earlier arrangements need not be elaborated, because in 1920 statutory provision for the co-partnership was, for the first time, incorporated in an Act of Parliament obtained by the Company. Briefly, this authorizes the shareholders to receive a dividend of 5 per cent. on old existent ordinary stock and 6 per cent. on new ordinary stock. These dividends are taken from the total yearly profit. All surplus profit is divided, three-quarters going to the consumers by reducing the price of gas. The remaining quarter is divided equally

between the ordinary stock holders by increasing their dividends, and the employee co-partners of the company by paying them a bonus on their salaries and wages.

It will be seen that an essential part of this arrangement is the allocation of three-fourths of the surplus profits to reduce the price of gas to the consumer. Hence it may justly be said that the consumer shares in the co-partnership. Since the gas company has a monopoly in its own district, it is essential that the consumer should be protected. As to the bonus which goes to the employees, this is treated in a special manner. One-half of it is invested in the company's ordinary stock, until the amount credited to any co-partner is sufficient to give him a stock certificate in his own name. The other half is held by the company and entered into a pass book which each employee owns. He can withdraw the money if he especially requires it, just as he could withdraw savings from a bank. All financial details are kept posted in the pass books of the employees. Further, the share-holding employees are able to elect their own representatives (not exceeding three) as Directors on the Board of the Company. Thus they take their share in management and control.

5. LEVER BROTHERS' SYSTEM

The late Lord Leverhulme was always a strenuous advocate of co-partnership methods, and he developed and applied a special system to his own business. His personal relations with the vast army employed by Lever Brothers' varied enterprises were certainly of the most cordial and successful character. The system is quite different in its details from that of the gas companies. To all employees there are presented co-partnership

certificates in proportion to the length and value of their services. These certificates entitle the holder to share in the profits available for the ordinary shareholders during the co-partner's connection with the business. It must be noted that these certificates do not confer upon the holder any real share-holding in the company, but only the right to share in profits under certain conditions. Lord Leverhulme was able to guarantee the arrangement because he himself owned all the ordinary shares.

Co-partners receive their first certificate on reaching the age of twenty-one, providing they have completed one year's service in the company. Once admitted they receive each year further certificates until they reach a maximum holding ranging from £200 to £3,000, according to their annual earnings. The actual dividend they receive is 5 per cent. less than the ordinary shares. There are other advantages offered to co-partners. At the same time those who leave the company's service have their certificates cancelled, unless for ill-health or old age, when a different kind of certificate, known as preferential, is given in exchange. Nominal values of certificates issued by the company amount to over two million pounds, and in the first fourteen years of co-partnership over one and a half million pounds were distributed in profit sharing.

6. CO-PARTNERSHIP IN THE COAL INDUSTRY

It is well known that the industry which has suffered since the end of the war the most disturbance and dislocation from long stoppages is the coal industry. Many official investigations and commissions have reported on this in order to ameliorate the animosity existing

between the trade union of the workers and the owners. In 1921 terms were arranged which practically took the whole of the workers into partnership with the mine owners.

First, there had to be determined the actual total amount of money received from the sale of coal. From this was deducted the costs of production other than wages. Of the remaining nett proceeds 85 per cent. had to be paid as wages, and the remaining 15 per cent. went to the owners as profits. Should the proportion for wages not be sufficient to pay certain stipulated minimum rates of wages, then the owners had to make it up from the 15 per cent.; and if the whole of this should not suffice, then money had to be found out of reserves or out of capital. The determination of the amount for allocation was made every three months, so that a profitable period in industry should soon be reflected in increased wages. Later, in 1924, under a National Wages Agreement, the proportion for wages was further increased to 87 per cent. of the nett proceeds.

This arrangement, arrived at under the pressure of continual threats by the trade union to create difficulties in the industry, and cause severe losses to the shareholders, proved, without doubt, to completely fail in its object. Notwithstanding the fact that it penalized those who owned the mines somewhat unfairly, yet after its establishment the intensity of the labour difficulties increased. Opinions without end have been expressed on this. Professor Henry Louis, a distinguished authority on the economics of mining, considered that the arrangement was foredoomed to failure because it did what no reasonably prudent man or business concern ever does—it divided all profits up to the hilt. What should have

been done was to set aside a definite proportion of the profits to form a reserve fund, from which both owners and workmen could have drawn when times were bad.

A true partnership in industry must accept the principle that both partners share in good and evil times alike. Partners who take their share of the profits in a good time must also bear their share of low remuneration when times are bad. This is the snag in the way of all co partnerships with labour—especially when the trade unions are concerned in the matter. Almost always they will not accept bad times with good grace. They desire the employers alone to bear them, and to confine their co-partnership to sharing in good times. It is a matter of mentality ; some call it psychology.

A multitude of other suggestions were put forward to help the coal industry succeed in its arrangement, and of these one offered by Dr. Bowrie of Manchester University had some interest. He stated that three years' service by workers should be a preliminary condition before being allowed to share in the advantages of co-partnership. Further, in order to secure a measure of goodwill from the trade-union leaders, he suggested that any man who left his union should cease to be eligible for a share in profits. This opinion obtained little sympathy from those engaged in the industry, not even from the trade-union leaders it sought to assist. Those leaders, who were at that time engaged in organizing the workers to violent extremes of opinion, were mainly opposed to all profit sharing and co-partnership for little if any cogent reason. One or two have said that a successful co-partnership would render the trade union superfluous, and tend to divert the workers' attention from nationalization and other socialistic projects. This would be

small loss indeed if co-partnership could so satisfactorily operate in practice that any industry to which it was applied became permanently prosperous and all its workers who were industrious better off and happier.

7. SHARE HOLDING BY EMPLOYEES

A difficulty that exists in arranging co-partnership schemes is that the law is very stringent in the matter of issuing shares. They can only be issued in exchange for property—*i.e.* a definite consideration—and they cannot be issued as payment for services. If this law were altered so that a workman or anybody else who rendered services to a company could have shares issued to him as a consideration it would inevitably lead to abuse. Nevertheless, the experiment has been given a trial in New Zealand by the passage there of the Companies Empowering Act of 1924, which enables companies to issue for services rendered shares ranking in every way equal, or *pari passu*, with others issued to those who contributed property. This experiment will be watched with great interest.

Since a share holding cannot be granted in exchange for services, it is necessary to make arrangements in operating all real co-partnership schemes, where ownership of shares must occur (otherwise a scheme cannot be termed true co-partnership), so that the workers are allotted first a cash share of the profits. This is then reserved for the purchase of shares. It is one of the fundamental principles in the gas company co-partnership, although in Lever Brothers' scheme, and in the coal industry, it has no place. Full co-partnership must mean having a share in the capital, in management, and in profits, and standing by the business in the bad times

as well as the good. Participation in profits is, of course, only one of the functions in a true partnership.

It is claimed that over two hundred satisfactory co-partnership schemes are now being operated in Great Britain. Some of the firms which have inaugurated them are distinguished pioneers in industry, but only a few of them are practising anything more complex than a participation in profits. Some, however, have instituted actual share holding by employees. The Federation of Master Printers appointed a committee to examine schemes of profit sharing and share purchase suitable for the industry. The report they issued deals with this aspect of the matter very thoroughly, and will be useful to those who have further interest in it. The details are too involved to be presented satisfactorily in this book.

8. PAST AND PRESENT EARNINGS

For several centuries the value of English money has been decreasing, and therefore the wages paid to workers has increased in money or token value. This is a matter of historical fact, and accounts of wages paid in the Middle Ages and later on are in existence showing how the artisan and the labourer have gradually had their hourly and weekly earnings increased. It is quite another matter as to how much the real or purchasing value of their wages has increased. It is, however, generally accepted that the standard of living has risen very appreciably since the time of the Industrial Revolution.

The nature of the steady general advance in wages since the middle of last century is shown in an interesting way in the following table prepared by Messrs. Denny

Brothers from the pay roll of their shipbuilding yard at Leven, on the river Clyde. All salaries have been excluded, and then the weekly wages paid to all classes of labour, including boys, engaged on production have been averaged.

Year	*Average Wage*
1852	13*s.* 2½*d.*
1872	15*s.* 2½*d.*
1874	24*s.*
1882	26*s.* 2½*d.*
1892	26*s.* 9½*d.*
1902	32*s.* 9½*d.*
1907	32*s.*
1911	34*s.*
1913	38*s.*
1925	56*s.*

During the period represented the cost of living steadily advanced, and the gain in money has to be set against the loss of purchasing power.

Turning to wages now paid to different types of workers, an examination will show very great discrepancies. The rates for unskilled and semi-skilled men vary from 9*d.* to 1*s.* 3½*d.* an hour ; those for skilled men from 1*s.* 2*d.* to 1*s.* 10*d.* Generally speaking, the workers engaged in sheltered industries are much better paid than those engaged in the unsheltered trades. Payment by results generally modifies weekly earnings to a very marked degree. Many other economic factors disturb normal arrangements. The great extension of the practice of subdividing labour involves a large number of workers doing nothing more than simple repetitive tasks, and many become so expert at one task as to

justify the payment of as much wages *while they remain on it* as anyone else is receiving, however much greater their skill.

As for comparing the earnings of British workers with their competitors in foreign countries, variation in the cost of living makes it difficult. In Italy skilled men are said to be pleased to earn 22*s.* a week. In Germany the author has seen highly skilled engineers receiving 4*d.* an hour for doing work which would earn at least five times as much in England. In America wages are enormously high, but the worker gives usually a larger output, and the cost of living is very inflated. All things considered, Great Britain has reason for claiming to have so arranged her industrial conditions that the workers have enjoyed a progressive advancement in their economic position.

9. MONEY WAGES AND REAL WAGES

The most important attribute of wages is their real value. This means their value in terms of what they can purchase. In other words, the essential matter is the product the worker receives for his service, and not the token money which has only a relative value. The purchasing power of money is always fluctuating. One week eggs will be 1½*d.* each, later on perhaps 3*d.*; milk is always dearer in winter than in summer. There are seasonal variations, and there are irregular and often long-continued rises and falls in the cost of living. Sometimes there occur extraordinary changes which may be described as epochal. With the general causes and effects of these the present book cannot deal. It is, however, often claimed by organizations of workers, generally trade unions, that the current cost of living

should determine the amount of wages to be paid, and this principle has been put into practice. It was applied, for instance, to the railwaymen, and it is the current practice in the Civil Service. In reply to a claim made by the Engineering Trade Union in March 1920, the Industrial Court of Wages made this ruling :

> " The remuneration of the various classes of workpeople should, in ordinary circumstances, depend on the value of the work done, and the value of the work done depends on the state of the market, and the demand for the products of the workshop. An alteration in the cost of living does not in itself necessarily warrant any corresponding alteration in wages."

This is the reasonable attitude which has generally been accepted. Nevertheless, some accommodation must be found when very considerable changes occur in the cost of living. It must be remembered that this cost of living depends mainly on the rate of the wages being paid, and if an increase in the former is met by an increase in the latter, then the former will rise again, and so on in a vicious circle of rapidly increasing costs. Such procedure would result in a disastrous slump in every trade which was unsheltered and exposed to external competition. In a country which lives largely by its exports this aspect assumes more than ordinary importance.

The general rule, acting over long periods of time, has been that the cost of living has decreased in proportion to average rates of wages, and this has allowed the standard of living among all industrial classes to improve. It is the universal wish that conditions may still further be improved. The consummation of this

desire will depend entirely on the goodwill shown by everyone to work diligently, and to accommodate themselves to those changing external conditions over which an exporting country can exercise very little real control.

The wider question of the permanent relation between real and nominal wages is a matter of economic theory, which is acknowledged to be complicated and full of difficulties.

10. FAMILY ALLOWANCES

The British wage system is constructed round the basic idea of the flat rate, which has assumed its importance from the technique of trade unionism. In bygone times wage inequalities reflected differences, not only of skill and power, but also of need. Similar causes are recognized in the increasement scales which many business and professional men, as well as those employed in the Civil Service, still enjoy. To-day any ordinary worker is assumed equal to every other worker in his trade, and the union claims that he must be paid an average, standard, or flat time rate. Any young journeyman, newly promoted to the full rate, perhaps because he has recently become a member of his trade union rather than because he has acquired any other recognized standard of skill, is at once paid a wage equal to his elder brother, father, uncle, or even his grandfather. While he may not be married, each of the latter may have a wife and children to support. The result is that their standard of living suffers. In fact, as a full-rate worker marries and has a family, so, step by step, does his standard of living fall.

A scheme for remedying this inequality by paying

family allowances has been advocated, and, in France, has already been put in force on the largest scale. Solicitude for the family, good ideals of employership, and the business motive of increasing goodwill are its reasons. The essence of the proposal is the provision of a family income consisting of the competitive wage of the breadwinner together with an extra amount provided in respect of dependents. It has been calculated that a flat rate of 3*s.* a week for each child under 15 would cost this country £76,000,000 a year.

There arises the difficulty in deciding who shall provide this extra 3*s.* a week for each child, not counting an allowance for a wife. There have been mooted three schemes :

(*a*) Payment from national equalization pools, one in each industry, as in France and Belgium.

(*b*) A system of National Insurance, in which the State may or may not provide some of the money. A contribution of 10*d.* a week from the employer, the workman, and the State in respect of every workman employed has been suggested.

(*c*) Direct State payment as with certain pensions.

The first is simply a method of taxing bachelors. The second and third are objectionable as far as they involve State payment from taxation and State interference in marriage and parenthood. It is said that all three militate against a spirit of independence and individual responsibility.

Many arguments have been advanced both against and in favour of the scheme. It appears a promising reform provided it is initiated in a voluntary way, as done in France since 1890, where the help or compulsion of the State has not been sought. It should be purely a matter of humane voluntary effort. The reform is

really a question of wages. Collective bargaining tends towards standard rates, standard hours, and a standard pace of work. Possibly some modification in favour of the married man at the expense of the unmarried would be a leaven of goodwill in social and industrial life. It seems a matter that may be left to the trade unions to advocate when they have agreed it will be a useful reform. At present they seem indifferent to it.

Chapter IX

HOURS OF LABOUR: STATE CONTROL OF INDUSTRY

I. HOURS OF LABOUR

ALL contracts between employers and employed usually contain, in addition to the statement of wages, an equally vital agreement about the hours of work, including the length of a working day or week. When employers' federations and trade unions make mutual agreements, these hours form one of the important economic relations. The rate of wages is applied to normal hours, and further work is overtime, to be paid for at agreed special rates, such as time and a quarter, time and a half, or otherwise.

Workers used often to be compelled to work long hours for low pay, and were said to be exploited or sweated. Such conditions in this country are almost, if not quite, extinct. Over ninety per cent. of the workers are known to enjoy a normal working week of not more than 48 hours. This has come about not so much by legislative compulsion as by evolution and social advancement, especially by means of mutual agreements between the two parties in industry. It is commonly said that the workers' standard of living has been improved by limiting his working hours as much as by better pay.

There is now an international movement to limit by legal compulsion the workers' week to 48 hours. This was inaugurated at the International Congress in Washington in 1919. The mainspring of the movement is the International Labour Office, a branch of the League of Nations at Geneva. It is intended to press for the necessary legislation in every country, but recently the movement has received a setback, which it is hoped by those who are interested will prove only temporary. Italy, for example, has definitely decided on a nine hours day, although previously she had given her allegiance to the shorter week. France was the first country to promote the necessary legislation, limiting all work to 48 hours a week, plus a maximum of one hundred hours' overtime in the year. Great Britain meditated following the French lead. Financial difficulties in France have caused her government to suggest a new arrangement of a nine hours day, thus following the path taken by Italy.

Considerable differences of opinion have arisen over this matter in England. There are many who think that the proposed international legislation is peculiarly injurious to this country. It is claimed that the other countries practise far too little government control over factories, administration is lax, and little is done to enforce the restrictions which they nominally accept. Further, there are many manufacturing processes, such, for example, as calico printing, where the idea is impracticable. A process cannot be stopped just when the factory hooter goes at, perhaps, a critical point in the middle of it, for the goods would be ruined. Orders which are being finished for a market like India must be completed regardless of working hours so that a certain mail ship may not be missed. An eight hours day and

a 48 hours week are mechanical and unreal limitations which cannot be woven successfully into the complicated and intricate machinery of modern industry.

On the other hand, all intelligent employers refuse to believe that long hours, sweated labour, and bad conditions are of advantage to industry. In fact, it is beyond argument that the future prosperity of industry in this country is bound up with reasonable hours of work, high wages, a very large output, and therefore cheapness of cost. Experience is beginning to prove that the 48 hours week and the 8 hours day form good average periods to yield a satisfactory volume of production, along with reasonable social expectations. Yet it must be conceded that rigid restriction of hours is not the best policy for all industries.

2. AGREEMENTS REGARDING WORKING HOURS

In the engineering industry the employers in 1919 reduced the working week to 47 hours. It had been 53 or 54 since the year 1871, when, as a result of a long strike, the nine hours day had been established. Wage rates were rearranged so that no reduction of earnings ensued consequent upon the establishment of the shorter week. In turn the trade union promised that the weekly output would not be diminished, which meant that more work would be produced in each working hour than before. What actually happened in many cases was that the hourly output was reduced instead of increased, as many employers had foreseen. It is interesting to note that Lord Weir, one of the employers concerned, computed that the decision would increase at one stroke the cost of British engineering products by £200,000,000 a year. There resulted the anomaly that while Great

Britain continued to purchase food and raw materials from abroad at prices little more than half as much again as in 1914, her own engineering products were offered for sale at prices considerably more than double the pre-war price. Purchasers were unwilling to pay so great an increase. For example, a farmer, say in South Africa, had to rear and sell many more head of cattle than he had previously done to purchase a plough. Consumers objected, and there ensued a great trade slump unequalled in severity, which had to be countered in the long run by drastic reductions in wages and a tendency to work overtime.

In the railway world the trade unions succeeded in the establishment of an eight hours day after the war. On the whole it appears probable that this length of the working period is fairest for the railwaymen, provided it is not made a matter of excessive inflexibility. At the same time it is apparent that the expense of operating railways has thereby been greatly increased, and at times causes grave concern for their continuing economic success.

The matter of hours of work in the coal industry has been the subject of persistent discussion. Parliamentary sanction to a legal maximum of eight hours a day was obtained in 1908, and under this law the industry prospered for five years. In 1913 signs appeared that the output and the prosperity might begin to decrease. Then the war ensued, which altered economic conditions. The trade union had not been contented with the eight hours day, and set itself an ideal of six hours' work. Discussion became very acrimonious, and, after an inquiry in 1919, the Government agreed to legalize a seven hours day. In practice this soon proved disastrous, the miners being unable to do sufficient work in the

period to justify a reasonable rate of wages. So in 1926 Parliament was compelled by sheer economic necessity to revert to the eight hours day, which the Act permits until 1931, when the situation will be once more reviewed.

A great deal of interest is attached to the economic failure of the movement organized by the Miners' Federation, and there is a multitude of reasons why British coal mines cannot be operated successfully under a legally limited seven hours day. One pertinent fact is that for every 100 miners actually engaged in cutting coal at the face there were employed 114 other persons in and about the collieries under the eight hours system. When the hours were reduced to seven it became necessary to employ 145 other persons, whose wages helped to increase the cost of the coal hewed by the 100 miners. This and other reasons caused the production costs to be so increased, while external competition was fierce and kept the selling price down, that in April 1926 the miners had reached the position that wages absorbed more than the whole of the money received from sales. The determination of the trade union to maintain the same level of wages and hours inevitably led to a stoppage of the industry, and there followed the most disastrous and costly trade dispute this country has ever experienced.

For the worker in Great Britain the consumer is often a resident of some foreign country, and the fact that it is he who controls the situation has been adequately proved, if it were necessary, by the successive collapse of the engineering, shipbuilding, and the coal industries under high wages, short hours, and reduced output. All exporting trades have to face this fundamental economic fact.

Industries which are termed sheltered, and do not either export or suffer competition at home from imported products, have a somewhat easier economic path to follow. In the long run, however, they too are subject to economic laws which remain unalterable. Only by using their sheltered position for the exaction of better terms have they been able to maintain their relatively superior rates of wages and working conditions, and this has often been achieved by other workers' conditions being depressed rather lower than might have been necessary.

3. THE FACTORY ACTS

When starting a factory it is necessary within the first week to inform the Home Office, or the local Inspector of Factories, giving certain particulars on a form which can be obtained. An inspector then comes to examine the building and conditions of work to see if they comply with the requirements of the Factory Acts. A set of the formal notices, which are abstracts of Acts of Parliament, to be displayed in a prominent position in the factory, is usually supplied by the inspector, or they can be purchased from H.M. Stationery Office. A register of various particulars as to employment, health, and accidents has to be kept. Afterwards an inspector occasionally calls at the factory and must be allowed entry at all reasonable times. Thus the Home Office keeps a check on all employers of labour and maintains the efficiency of legislation.

Government control of factories began after the Industrial Revolution had brought about changed conditions in industry. At first it was designed more especially to remedy the evils attendant on the employment of children in cotton mills. It is not necessary to

recount the early years of this legislation, which commenced about 1802. The first important Act was that of 1833. The hours of labour for children under thirteen were limited to nine a day, and for "young persons"—*i.e.* from thirteen to eighteen years of age—to twelve hours, and provision was made for the creation of a staff of inspectors to see that the law was obeyed. In 1844 adult women were first protected. Again in 1847 the working hours of young persons and women were reduced to ten a day, six days a week. Then in 1864 industries outside the textile were brought within scope of State control. So numerous did all the Acts of Parliament become that in 1901 there was passed the Factory and Workshops Act, which embraced and consolidated preceding legislation and forms the basis of the existing law. Now no child under fourteen may be employed in any factory or workshop.

In 1901 the number of working hours a week for women and young persons was legally reduced to fifty-five and a half in textile factories, and sixty in non-textile factories. The hours of labour for men have not yet been regulated by law. In a new Factory Act a maximum number of forty-eight hours a week plus one hundred for overtime during the year is proposed. This follows the system which has already been made legal in France. Other matters already regulated, such as sanitation, heating, ventilation, lighting, humidity, cubic capacity of space per worker, guarding moving machinery, are to be more strictly controlled, as well as factory facilities for escape in event of fire, and other precautionary arrangements.

4. EMPLOYERS' LIABILITY AND WORKMEN'S COMPENSATION

In earlier days factory industry and coal mining were prolific of accidents, and much misery followed, but to-day matters are different. The causes of accidents have been brought under rigid control and greatly reduced, and when they do occur a widely extended system of compensation to the injured is compulsory. Before 1880 any worker who was injured while carrying out his proper work could only obtain compensation from his employer through a civil law action. He had to prove personal negligence by his employer—a very difficult matter. This was changed by the Employers' Liability Act of 1880 and the Workmen's Compensation Act of 1897 which, together, made the employer liable for accidents resulting in injury or death, caused by defects in works, plant, or machinery, independently of negligence. The employer has to pay compensation to an injured worker, or his dependents if he dies. An amending and extending Act followed in 1906, another in 1923. Great Britain has pioneered this legislation, and most countries have now followed it. It possesses the highest social and moral value.

Usually in industry the risks from the responsibilities which fall on an employer from this legislation are insured against with some suitable insurance company. A premium is paid yearly, based on the wages paid and the type of industry carried on, risks of accidents varying greatly from one to another. Records of accidents have to be kept in every factory. Claims are reported and turned over to the insurance company for settlement. False claims are sometimes made, but are the exception. Finally, it must be remembered, if any accident arises

through an employer neglecting to provide proper protective devices in a workshop, such as are required by the Factory Acts, then he can be prosecuted quite apart from the matter of compensation to those injured.

5. UNEMPLOYMENT

From the nature of the terms under which workers hold their situations they sometimes find themselves without work at the expiration of a very short notice. There are industries, like the railways, where employment is steady and continuous, and a worker may normally anticipate uniform conditions of wages and work for the remainder of his life. But in others, when a particular job is finished a man has to seek a fresh one with another employer. House building is an example where labour turnover from job to job, from employer to employer, and often from place to place, is the ordinary prevailing condition. This leads to enforced idleness between jobs which is very wasteful. It becomes valuable and necessary for the employed worker to know where to find help immediately he has to seek a fresh engagement. Some trade unions have kept a register at their offices for this purpose, and then employers can apply direct to the union headquarters for additional men. For example, the London Printing Trades do this.

The Employment Exchanges of the Ministry of Labour were instituted by the Government to provide these facilities for all workers. This is now a recognized part of the administration of the national unemployment insurance scheme. Labour exchanges, properly used, render important services to employers and workpeople as clearing centres for vacancies and applicants, and

records show that about one and a quarter million positions are filled annually with suitable workers by this means. The nature of the services rendered by the exchange differ greatly according to the locality. In a large town there will be a variety of trades and industries, and a register of perhaps 5,000 unemployed will show a rate of turnover of employment more rapid and of greater economic importance than a similar exchange in, say, a coal valley, where periods of long and continuous idleness in the limited number of industries there located may have become endemic. In the city, with its numerous small establishments and variety of trades, the exchange properly used can render an important service to employers and workpeople. In the coal valley the closing and reopening of the few mines or works is a matter of immediate common knowledge, and the exchange can do very little to smooth out periods of unemployment and slack trade.

6. UNEMPLOYMENT BENEFITS AND INSURANCE

When trade is bad and workers are compelled by the prevailing economic conditions to suffer long periods of enforced idleness, their morale as well as the physical condition of themselves and their families may suffer great damage. While poor relief can be resorted to in the last extremity, and the nature of this should compel all to regard it as only the last safeguard against starvation, it will appear that some definite procedure must be arranged to mitigate the hardships of unemployment. These hardships in past times have been a veritable nightmare to the worker. Some of the trade unions were the first to organize out-of-work benefits, notably the Amalgamated Society of Engineers. Other unions, like

those in the printing trade, have given marked proof of their capacity to develop benefit payments. Certain Friendly Societies and Industrial Insurance Societies have had their schemes at work for many years past.

However, these arrangements only touch the fringe of the problem, and it became advisable for the Government to introduce a compulsory system of National Unemployment Insurance. It was first started and limited to certain trades in 1912, but after eight years the scope had widely been extended, most workers, except those engaged in agriculture and domestic service, having been included. The Ministry of Labour administers the scheme. Each worker has a card to which stamps are affixed every week—for men, 1*s.* 3*d.* a week; for women, 1*s.* 1*d.* a week; for young people, 6½*d.* a week. Of this the employer pays 8*d.*, 7*d.*, and 3½*d.* in each case respectively, and the worker the remainder. The total fund at one period became indebted to the Treasury for more than twenty-one million pounds, and was insolvent to that extent. All this extra money required to meet unemployed benefits had been advanced from Government funds. The fact that the system is not self-supporting gives some justification for the use of the term " dole " for this species of benefit. The maximum indebtedness to the State was actually limited to twenty million pounds by Act of Parliament, but this sum has been proved insufficient. The correction of the relation between benefit paid and subscriptions received is a matter of actuarial practice and depends on the assumption of correct risks of unemployment, a naturally difficult and involved subject.

7. ABSENTEEISM

The effort made in recent years to improve the worker's standard of living, and to reduce the number of hours in the working day or week to the very minimum that will enable industry to be carried on at all, has drawn attention to the amount of time and wages often voluntarily lost by workers refraining from attendance during the agreed hours. This is known as absenteeism. If the obligatory working hours are to remain at a minimum, it is important that voluntary absenteeism should also be reduced to a minimum. A certain amount of absenteeism is unavoidable from causes which are obvious and need not be detailed. It is the avoidable absenteeism which causes unnecessary difficulty and financial loss. In the coal industry it was at one time shown how the whole of the workers sacrificed an average of 5 per cent. of their earnings—*i.e.* one shilling in every pound—by absenteeism.

Such voluntary absenteeism is the direct cause of considerable economic loss to others. When a large body of workmen withdraw themselves from their day's work their employer is left to bear all the standing charges without receiving any output to pay for them. This adds to the prime factory or mines cost of a product. It is anomalous that this should happen, just as much, in fact, as it would be if the managing and controlling staff shut down a works because they wanted a day off, and thus prevented the workers from earning their wages that day.

8. RESTRICTION OF OUTPUT OR CA' CANNY

An economic fallacy current among workers and trade-union officials is that if everybody works hard there will

not be enough work to go round and some workers will be thrown out of work. It is known by economists as the lump of labour fallacy, and the policy is often called "going slow" or "ca' canny." It leads on to the pursuit of a general policy, first to eliminate all overtime, then to reduce working hours. This must be distinguished from a legitimate desire to improve standards of working-class life by doing away with unnecessary overtime and diminishing the hours of toil.

Ca' canny arises from an entirely wrong point of view. The economic truth is that the more work there is done the better off everyone becomes. It has been said that "if everybody works there is work for everybody." The more goods there are manufactured the more there must be to go round. No community can improve its condition by limiting supplies of food or manufactured goods. This is a truism which should be obvious to all.

A foolish opposition to labour-saving, or, as it has been better termed, labour-aiding machinery, arises from ca' canny. The idea that machinery displaces men is true in a temporary sense, and this supports the antipathy workers have to its unlimited introduction. But in the long run everyone benefits and there is more work for the workers themselves to undertake. Any temporary hardships which arise from readjustments consequent on a growing use of machinery are now amply mitigated by the national unemployment insurance scheme.

Some trades are continually accused of deliberately going slow in work. Bricklayers, for example, are said to have decreased the number of bricks laid every day so much that it has become one of the basic difficulties in the national housing problem. Trade-union officials have sometimes been reproached for encouraging the

ca' canny fallacy. It has certainly been advocated by some of the leaders in their writings. Definite printed rules of the unions are seldom found dealing with this, because it is a subject more suited to be included under powers of district committees. However, occasionally such a statement as the following by the National Union of Foundry Workers is found: "Any member having so much time allowed for certain jobs shall be compelled to absorb the whole of such time on the task or be fined £1 for each offence." Again, "Any member doing more than is considered a reasonable day's work shall be reported to Shop Committee, who will warn the member, and if such warning be ignored, complaint will be made to Branch Committee, who shall investigate the case, and, if the member or members be found guilty, a fine of 20s. will be imposed. On a repetition of the offence the member will be liable to expulsion."

Generally, restriction of output is regarded by the workers as a defensive action against conditions they consider unfair. When brought about deliberately it can usually be detected by a remarkable uniformity of output over a long period. It is rare in factories which possess a good mental atmosphere. Causes of restriction have been given as follows:

(1) Fear of rate-cutting.
(2) Uncertainty of tenure of job.
(3) Defects in piece-work or day-rate systems.
(4) Fear of discharge among the less competent workers, who persuade the others to support them, possibly through a trade-union branch.
(5) General dissatisfaction with conditions.
(6) Unsatisfactory influences of a foreman.
(7) Satisfaction with present rate of earnings and lack of initiative or desire to earn more.

It is an essential duty of those having the responsibility of management to see to it that such fear and dissatisfaction and bad influences are eliminated by inculcating a better and more healthy morale. A feeling of security and fair treatment will do a great deal towards countering an unsatisfactory outlook among the workers which degenerates into ca' canny. Indeed it appears a disease which good management should be able to cure.

9. ARBITRATION: THE INDUSTRIAL COURT: WHITLEY COUNCILS: TRADE BOARDS

In order to facilitate the settlement of differences of opinion and disputes that may arise between employers and their workpeople, the Government has, from time to time, introduced and administered methods of procedure under which the two sides can meet and, by common discussion, compose their differences. The Industrial Court has been set up under its own president and officers. It has assessors attached to it which are selected from organized employers and trade unions. When a dispute arises the matter is investigated and a decision pronounced by the Court.

Whitley Councils are formed within an industry. They consist of equal numbers of representatives of employers and employed, and they investigate matters brought before them by either side, and try to compose their differences. They have been found of considerable utility.

A Trade Board is set up by the Government in an industry where the workpeople are not sufficiently well organized to be able to exert any collective influence regarding their wages or conditions of work. The Board determines minimum wages and hours of work, and im-

poses these as minimum conditions to be observed by all employers in the industry.

All the above methods of arbitration and negotiation between employers and their workpeople do not pay sufficient attention to the point of view of the consumer, who is the party who pays for the products of industry. Hitherto there has been a too obvious tendency for trade unions to use the conciliatory methods which have been introduced as an additional means of bringing pressure to bear on their employers. Concessions have often been obtained against the better sense of those who are unprejudiced, and in due course the inevitable economic reaction has proved them untenable and they have had to be abandoned.

Chapter X

TRADE UNIONS

I. TRADE UNIONS

TRADE Unionism is one of the most striking characteristics of industry, and is of fundamental economic importance. A thorough understanding of its history, development, and present degree of organization is a necessity. Looking for a moment at history, the fraternities of journeymen who formed the Craft Guilds of the Middle Ages practised combination, and it has sometimes been said that those old Guilds were really original trade unions. This, however, is not an accurate view. For many reasons, one being that the Guild members were employers as well as workers, they cannot be looked upon as true predecessors of trade unions. Craftsmen of all ages in every country have naturally combined for self protection as they did in the Guilds, but the modern trade union is a recent development and has no lengthy history behind it. A claim is made by the Silk Hatters' Union to have enjoyed a continuous existence since 1576, but this is exceptional. Of the large craft unions, that of the Friendly Society of Iron Founders dates from 1809, and the Amalgamated Engineering Union, which prides itself upon being the first union to have formulated the true functions of these organizations, was formed in 1851. The big industrial unions and those of the un-

skilled workers are of still more recent formation. The National Union of Railwaymen dates from 1872, and trade unions among the miners were revived about the same time.

The Amalgamated Engineering Union (A.E.U.) was the first trade union to adopt the characteristics of high rates of contribution and the distribution of friendly as well as trade benefits. It first combined the idea of mutual insurance against sickness, accidents, and death, with the provision of strike and out-of-work pay. There are now about 1,150 trade unions in Great Britain, the membership being approximately 4,500,000 men and boys, a number which tends to diminish, and 800,000 women and girls, which number tends to increase. Many of the members, such as teachers, journalists, and civil servants, are not workpeople in the ordinary meaning of the term. There are more than ten million workers not in trade unions, so that the non-unionists greatly outnumber the unionists.

The total yearly income of the trade unions is about ten million pounds, derived mainly from weekly subscriptions from the members. In some unions the subscription is over 5*s.* a week, in others only 2*d.* or 3*d.*, the average being about 8*d.* a week. It is interesting to study how this large income is spent. A recent year's returns show that it is nearly true to state that one-half of all the contributions is spent on officials and offices. This is the average, although there are trade unions which spend nearly all their income on management expenses. Taking the unions as a whole, the Chief Registrar of Friendly Societies states that the average contribution per member is 36*s.* a year, and of this they spend 17*s.* 4*d.* in benefits of all kinds, including strike pay, 14*s.* 8*d.* in management expenses, and 1*s.* on political objects.

Their management costs a very much larger proportion of their income than that of the great friendly societies and industrial insurance societies. In explanation of this, certain officials of the unions have stated that it is not so much a matter of how the income is spent provided that the unions continually seek for their members better conditions of employment, higher wage standards, prevention of reductions, and reduction of the hours of labour.

2. INDIVIDUALISM AND COLLECTIVE ACTION

Before the objects of trade unionism can be correctly appreciated, some general matters must be considered. There are two philosophic principles which are concerned with the relations between different men; one is individualism, which is simply each man acting for himself, and the other is collective action, where men join their forces for the pursuit of some object. The former has been described in the following simple words:

> "Each man and woman is to be free to direct his or her faculties and energies, according to a personal sense of what is right and wise, in every direction except one. A man is not to use his own faculties for the purpose of forcibly restraining his neighbour from the same free use of his faculties."

The keenest supporters of individualism are generally men who have been able to rise above the heads of their fellows. This especially applies to successful self-made men, who are really the products of the system. Outstanding personal ability and force of character are greatly encouraged by the individualistic and competitive system of industry. This is possibly its greatest advan-

tage. It cannot be doubted that the British Empire has been created mainly by this type of man.

The doctrine and practice of individualism has been part and parcel of life in Great Britain for many generations. It considers the community should be a collection of separate individuals enjoying the maximum personal freedom. It maintains that it is everyone's duty to dispose of his labour and skill for the highest return, and equally it is everyone's duty to hire labour and skill and obtain the results they yield at the lowest possible price. In the competitive spirit which exists there is, it is argued, the best scope for human ambition for betterment.

The practice of individualism received a great impetus at the time of the Industrial Revolution. The older historical social system into which men had fitted themselves in horizontal grades having been broken up, it became the fashion to regard all men as thoroughly capable of looking after their own prosperity and happiness. By leaving each man free to seek his own ends in his own way it was thought that all would achieve the greatest happiness and the nation the maximum prosperity.

3. COLLECTIVE METHODS

Collective action, meaning combination in pursuing an object, is also an old general philosophic principle. It might be called collectivism, only this particular word has assumed a special and limited economic signification attached to it by modern French moralists to identify a subdued type of Socialism. Combined action was practised by the Craft Guilds in order to protect the interests of their members. To-day shareholders combine their resources to form great industrial corporations. The practice of insurance is another form

of mutual combination for the advantage and protection of the individual. Socialism is an advanced form of similar ideas, but it aims at the universal compulsory enforcement of collective ownership and mutual methods. Many people remain convinced that it is best to leave the individual sufficient personal freedom to decide for himself whether he wishes to remain an individualist or to become a member of a group which co-operates. Methods of joint action and combination have made great progress in industry both by workers and employers.

Trade unionism is the form in which collective action by the workers has developed. It must always be borne in mind that trade unionism was first created in England, and that it preceded socialist doctrines. The term Socialism, as opposed to Individualism, was coined in 1838 by Pierre Leroux. Socialism arrived first on the continent of Europe, and developed its activities along various paths, of which trade unions formed one. In this country the trade unions have been inclined of late years to adopt socialist theories coming from the Continent. This connection between trade unionism and socialism is of considerable interest in the current march of events, but beyond indicating that socialism is opposed to individualism to a much greater extent than trade unionism has hitherto been, the matter is too involved to receive adequate treatment here.

4. THE MOTIVE OF TRADE UNIONISM

The theoretic notion that men are all equally gifted or endowed for the struggle for existence is obviously wrong. For the well-equipped it may be the most bracing of all experiences, and lead to success; for

others, thrust perhaps into the struggle too heavily handicapped, it has often led to an unmerited degradation. It is this incidence of the natural inequality between men which brought the trade unions into being. It would be idle to pretend that an employer and an individual worker stand on an equal footing when negotiating a contract of wages to be paid, hours to be worked, and other labour conditions. Nominally the worker could refuse to sell his labour for an unfair price, but this freedom, upheld by the doctrine of individualism, is in reality a shadowy abstraction. The workers were oppressed by the combined power of employers and consumers, and the social need which resulted from their degradation caused trade unions to be called into existence. These devised their well-known collective methods, to bring pressure on employers to grant reforms which they collectively desired. As long as these reforms are fair to the employer, and as long as the men's leaders are actuated by no other motive than to obtain what is reasonable, there is little to be said against the principle of collective bargaining.

In general terms the motive of trade unionism may be expressed as "maintaining and improving the workers' standard of life." This is achieved by developing and applying to the full methods of co-operation and joint action. By dint of organization, active propaganda, and considerable success, the trade unions have risen to great power; but symptoms are not wanting that their doctrines and methods are becoming too unaccommodating—almost, in fact, tyrannical—and movements are in progress for checking bellicose trade unionism just as it checked in the past the unfairness of free and unfettered individualism.

5. THE LEGAL STANDING OF TRADE UNIONS

The pioneers of trade unionism were men who were faced with rapid changes in factory production, with a continually increasing economic pressure exerted on the workers, coupled with reluctance on the part of employers to assume any responsibility for the physical and social welfare of their employees. The economic status of most of the workers had become altered during the period of change over from the older Domestic System to the modern Factory System. The economic independence of the worker had vanished, the tools he manipulated were now the property of his employer, whose servant he had become. In their early days the trade unions had to bring about the improvement of wages and conditions, when there was no other influence working to this end.

But the unions did not achieve a legal standing in the country without considerable opposition. Long before, in 1425, confederacies of journeymen had been made illegal, and from that date onwards a combination of workmen for the purpose of affecting wages or work in any way was considered a conspiracy. So the early trade unions were regarded as illegal associations because they acted in restraint of trade and, therefore, against common law. It was an ancient rule, and opinion gradually came round to the view that it was straining its application to use it to prevent voluntary combinations by workmen to advance their common interests in the trade in which they were employed. Privileges were granted to trade unions because it was assumed that they were and would continue to be voluntary associations.

In 1825 they were first recognized as legal societies,

and this was extended in 1859. Next the Trade Union Acts of 1871 to 1876 were passed, which amended the whole position. They were now fully protected from vexatious prosecutions for criminal conspiracy. These Acts are known as the Trade Union Charter, and what they amount to is that the weight of the State was then directed to giving these organizations fair play.

Again, in 1906, there was passed the Trades Disputes Act, which is a landmark in the history of trade unions, because it afforded substantial protection for their funds from all actions taken against them at law. Funds collected for benefit purposes could not be taken in execution to satisfy any judgment creditor in respect of some claim in no way connected with the benefit part of a trade union's business. It therefore freed them from liability for their own torts or wrongful acts; in fact, it placed them above law. The actual wording (Section 4, 1) of the Trades Dispute Act of 1906 is as follows:

> "An action against a trade union, whether of workmen or masters, or against any members or officials thereof on behalf of themselves and all other members of the trade union in respect of any tortious act alleged to have been committed by or on behalf of the trade union, shall not be entertained by any court."

The same statute also legalized peaceful picketing. These special privileges have had to be reconsidered in view of certain developments of trade-union policy.

6. METHODS OF TRADE UNIONS

The principal objects of a trade union, as defined by the best of their own leaders, are to protect the trade

interests of its members, and to strengthen their position by bargaining with their employers regarding the conditions of labour. These objects are chiefly attained by supporting their members when engaged in a collective dispute by dispute benefit (strike pay), and to support with unemployed benefit those of their members temporarily out of work, so that they will not be compelled to accept work on terms worse than the minimum conditions required by the unions. All trade unions provide strike pay in some form or other, but unemployed benefit is not universal, while other benefits are the exception rather than the rule.

The chief activities of a modern trade union are directed along the following lines :

(*a*) It continually presses for increased wages and reduced hours.

(*b*) It negotiates a minimum wage rate, called the " standard rate."

(*c*) It negotiates the number of hours in a working day or working week.

(*d*) It arranges limits for overtime, and suitable rates of pay for it.

(*e*) It restricts the numbers in a trade by limiting apprenticeships, and sometimes by preventing movements of unemployed from one district to another.

(*f*) It restricts or regulates piece-work conditions.

(*g*) It demarcates the kind of work which properly belongs to its trade.

(*h*) It restricts encroachment by unskilled workers.

(*i*) It tries to monopolize work by refusing to work with non-unionists.

(*j*) It devotes some portion of its income to the support of members of Parliament and labour

political policy, nominally with the view of ensuring and consolidating its industrial position.

Some trade unions have pursued internally a policy of mutual benefit, of which the following comprise the functions :

(*a*) Provision of safeguards against disease and accident, and payment of death benefit.

(*b*) Compensation for disease and accident arising out of the work.

(*c*) Provision against unemployment.

In this latter respect they may be said to have originated some activities which the State has since taken up and applied to the whole of industry.

The methods pursued by trade unions are thus clearly defined by their own leaders, and, in a general way, they have been accepted by most people as justified by the nature of their ultimate aim, to improve the conditions of life for the worker. A considerable actual improvement has happened coincident with the rise to power of the unions, and there can be little doubt that the movements are connected. But it is not by any means certain that the trade unions alone have effected this. Furthermore, there is a body of opinion which increases rapidly and openly questions whether the relentless pursuit of one policy regardless of circumstances has not now become a potential danger to the economic fabric of industry. Say what they will, trade unionism is essentially selfish at its core, and, even if it represents the beliefs of the five million members, which is open to considerable doubt, it certainly, at best, only represents a minority of the workers, and a still smaller minority of the whole community.

7. STOPPAGES IN INDUSTRY

It must be clear to everyone that in a society where all men are free, any one man can always refuse to employ or be employed by any other man. As soon as there is interference with either right, men must lose some measure of their freedom. At the same time it is the usual practice for employers and employed to enter into a voluntary contract, one to pay a wage, and the other to serve for a definite period of time, which may be as short as one hour or may extend to a week, month, or even some years. Providing any such civil contract is not broken, it follows that a workman, who is not satisfied with the conditions under which he works, possesses complete liberty to leave his work. If the employer, for his part, is not satisfied with a workman he can always dispense with his services.

The trade unions were not long in discovering that this privilege which free men had won and enjoyed could be organized by joint action into what is termed in union phraseology " a weapon." For reasons already explained it has been found conducive to general improvement in standards of living if workmen are left free to arrange joint action in refusing to work under unsatisfactory conditions. The worker in his normal individual capacity is too weak to force changes, but by combining and acting jointly the employer who stands up against their wishes is placed at a disadvantage, and may have to yield to superior power what he refused to yield under discussion, whether he is right or wrong.

In this way workmen are said to strike. It has long been recognized that by using this economic weapon against the employers there has resulted in the past a good deal of improvement in standards of life among the

masses of workers. Hence Parliament has afforded special recognition to trade unions. The worker is definitely entitled by statute to possess the right to withdraw his labour either as an individual or in combination with other workers at the expiration of whatever notice is required by the contract of employment.

8. STRIKES AND LOCKOUTS

A strike is a stoppage of work generally ordered by a trade union when concessions cannot be obtained from employers. Employers have also adopted similar tactics in their own defence, and when, for some reason, they decide to stipulate that employment must be on their own terms, and dismiss the workers who refuse to agree, they are said to lock them out. The organization of workers into trade unions, and employers into federations, has greatly strengthened the facility with which both sides can negotiate mutually satisfactory agreements. Sometimes these agreements are national in their scope; at other times local. When disputes cannot be settled by such agreements it becomes a matter of "might is right."

Strikes and lockouts have been practised in Great Britain for the past century, and there is no room here to attempt to describe them. One or two may, perhaps, be mentioned. In 1871 the engineers, who, it will be remembered, possessed the first highly organized trade union, struck to reduce their hours from fifty-nine to fifty-four a week. They desired to have a nine hours day. Considering the great advances which engineering processes had made, it seems to have been a very reasonable demand. The employers foolishly opposed it, but after twenty weeks conceded the point. It is inter-

esting to note that some years later, in 1919, the employers voluntarily further reduced the hours to forty-seven a week. Notwithstanding the last great step forward in friendly relationship it was regrettable that an intractable attitude towards employers by the same trade union in 1922 caused the enforcement of a stern lockout. After fourteen weeks the union abandoned the struggle. This lockout was noteworthy for the great number of men, it is said over 200,000, who left the union, and it was agreed that if the employers had wished they could have completely broken the power of the union. The federation of engineering employers did not wish to do this, as in this industry they prefer to negotiate with organized labour on a national basis.

9. DEVELOPMENT OF STRIKES

In recent years the doctrine of striking has been extended by the trade unions. There has been brought into use the sympathetic strike. This means that if one group of workers go on strike in an attempt to improve or maintain their standards, other groups of workers will also declare themselves on strike, not to improve their own economic position, but to support the claims of the others. If this principle is extended far enough a general strike is arrived at, and this was attempted in May 1926, and ended, as it happens, in complete failure.

The ordinary strike or lockout is a trade dispute, or stoppage. It is conceivable that the sympathetic strike, and even a general strike, could also be classified in the same category. Some leaders of trade unions have officially claimed that the 1926 general strike was a pure trade dispute, entered upon in support of the

standard of living of all workers, which they maintain was to be attacked generally by first reducing the standard enjoyed by the miners, and then attacking the others piecemeal. Other trade-union leaders have deviated from this view. For example, the industrial secretary of the Railwaymen's Union, which took part in it, has stated that the object was political, to force the position of the Government, possibly to make them resign. His words were: "In spite of the denials of the General Council of the Trades Union Congress (denials made during the strike and obviously for the purpose of reassuring the timid) the issue was a constitutional one. If successful it did involve a revolutionary change in their methods." The majority of people agree with him that a general strike is an attempt at political revolution.

The general strike of 1926 was fought by Parliament, and it was soon evident that it possesses ample powers to break this form of revolution. Parliament did not grant the trade unions an honourable status in the community to foster any kind of political revolution. Consequently, this general strike has been followed by a movement to make illegal both general strikes and sympathetic strikes, and to curtail certain other privileges trade unions enjoy. Some workers, such as those engaged on vital national services and including all civil servants, are now prohibited altogether from striking. These questions are, at the time of writing, more a matter of politics than industry, and therefore will be left at this point.

10. THE ECONOMIC LOSS FROM STOPPAGES

Before 1907 the average annual loss of working days from stoppages amounted to about 3,000,000 a year. Between 1907 and 1918 this average increased to about 12,000,000 a year, notwithstanding the fact that throughout this period the general standard of life enjoyed by the workers was steadily improving. When the Great War had finished, definite steps were taken further to improve all the conditions surrounding the lives of the workers. An eight hours day was granted the railwaymen, and their weekly wages increased by over 150 per cent. The miners obtained remarkably favourable terms, including a seven hours day, and also a co-partnership right to take 87 per cent. of the nett proceeds in the industry. Builders enjoyed the reduced maximum working week of forty-two hours. The engineers were granted a forty-seven hours week and other more favourable conditions. Innumerable other advantages accrued to all workers.

These facts can now be compared with the statistics of stoppages which have since occurred, bearing in mind previous records. From 1919 to 1925 the average annual loss of working days increased to 28,000,000, and in 1926 the total for the year amounted to the enormous figure of 180,000,000. These figures tell their own tale, and it must be remembered that in none of them is any account taken of the great number of other workers involuntarily thrown out of work by action of the strikers. If an attempt is made to estimate the direct loss to the country from the strike of miners in 1926 it yields a figure somewhere between 400 and 600 million pounds.

One thing these figures prove quite definitely is that

the present constitution of trade unions leads to the paradox that the better off the workers become the more they strike. It can no longer be thought that stoppages, however arising, are most prevalent when the economic conditions are at their worst, and the wages of the workers at their lowest. It is quite the reverse. The higher the wages paid the greater the prevalence of trade disputes. At present an effective way of dealing with this great problem in industry is being widely sought.

Workers have been encouraged for years past to believe the owners and employers their natural enemies, and the interests of both sides to be regarded as mutually inconsistent. What this has led to in organized stoppages has just been seen. Yet the condition of affairs trade unionism was designed to meet, namely, the exploiting of labour for the inordinate benefit of the employer, has ceased to exist in this country. It may be said definitely that many, if not most, stoppages are the outcome of the abuse of collective organization. Individuals, when organized collectively, leave to others the expression of their thoughts and wishes. Thinking done collectively seems soon not to be done at all. The mechanism of organization masters and suppresses all individual effort and personality. The workers lose control of the officials which their subscriptions maintain, and the machine of trade unionism sympathizes with policies which are more likely to destroy the means by which the individual worker lives rather than to improve his standard of living.

Chapter XI

EMPLOYERS: CAPITAL: MANAGEMENT

I. EMPLOYERS

In Great Britain there is no well-defined class that can be described as peculiarly the owners of industry, and therefore the employing class. Ownership is distributed throughout the community. Many workmen hold shares and stock in industrial concerns, and are both employers and employed. The idea that employers are a small special class of men apart from the rest of the community is a facile exaggeration beloved of ill-informed social agitators—as a fact, it is completely untrue ; indeed, it may well be described in the picturesque language of Hollywood as flub-dubbery.

The four great railway companies of this island, worth 1,400 million pounds, are owned by more than one million shareholders. It is interesting to note that they employ about 700,000 workers. Here the owners outnumber the workers. The figures in road transport, that other method of carrying passengers and goods often competing with railways, are equally interesting. The capital is about £250,000,000, the number of shareholders 600,000, and workers 800,000, excluding those engaged on the manufacturing side. Ownership in the shipping industry is distributed among 300,000 proprietors, and the average holding is something less

than £500. The coal mines are owned by 152,000, the average share of each being less than £2,500.

The same truth applies to all the other branches of industry; proprietary rights in them are widely distributed, and more often than not among persons of moderate means. For half a century the loan system of providing capital has been in operation in the Lancashire cotton trade. It has developed an understanding between employers and employed which is the admiration of other industries. Many Nottingham miners are declared to hold financial interests in the coal mines in which they work, and their influence has been one of the potent causes of an anti-strike policy there. The existence of joint stock public companies makes it easy for anyone to purchase shares at their market price. In this way proprietorship may be assumed in an industrial enterprise. It is a matter of saving money and investing it in industry, thereby providing some portion of the vital capital.

In the basic industries of the country there are more than two owners for every three workers. This is a fact of some importance, since the trade unions maintain an attitude of considerable hostility to owners, and their appeals for public sympathy are usually based on the assumption that a comparatively few employers wish to coerce a great number of workers. The truth is that the total number of owners of industrial enterprises in Great Britain actually outnumber the members of trade unions. It must be remembered that two-thirds of the workers still remain outside the unions, and, therefore, if all owners and all workers are taken into consideration, the proportion will probably be about two to three, just as statistics prove exists in the basic industries.

2. SHAREHOLDERS AND DIRECTORS

In the majority of cases the patient shareholder, whose hardly earned savings are the backbone of enterprise, is a person of slender means. He often gets a poor return for his money. In 1914 the average profit in the whole engineering industry was about 4 per cent.: it has since become even less. A shareholder in his individual capacity may have little personal influence in the management of the industry in which he is interested, but collectively the shareholders elect some few of their members to be directors. These together form the Board of Directors and assume the duties of management. Usually they appoint one of their number to be Chairman, and one or more to the position of Managing Director. It is customary in British practice for the authority of the Board of Directors to be delegated directly to the Managing Director. He, in turn, will be assisted in most of his duties by a general manager. Often the directors themselves act as the principal administrative officers.

Boards of the large public companies are assuming more and more the character of a group of experts in special departments of the business, all seeking after maximum efficiency, and operating under the control and reviewing power of the whole board. Each individual is called upon to make the best of favourable conditions and to strive to overcome the unfavourable. The directors of an important company are often the hardest worked men in the whole organization.

3. JOINT STOCK CAPITALISM

For a long time factories were owned by private capitalists. A man would not only provide the money, but also would work in his particular business directing the whole enterprise. Those old-fashioned manufacturers were often strong in morale. The type of employer who, as a boy, grew up among his father's men, knew old and young by their Christian names, a condition rapidly dying out, held an enormous advantage in morale. There existed a strong family pride among the former generation of captains of industry.

The tendency for units to get bigger and bigger asserted itself, and in 1855 and 1862 there was initiated the series of Acts of Parliament controlling joint stock companies with limited liability. In the place of family pride, fellow feeling, and personal management there arose the impersonal joint stock combinations. Their capital may be provided by many thousands of shareholders, and the actual industrial affairs are controlled and managed by salaried officials. No man corresponds to the older type of master who owned and controlled his own business, and was, perhaps, personally acquainted with every one of his men.

To-day shareholders, as a rule, do not even know each other; they are called together only once a year to meet their directors at the annual general meeting. Their main concern is the receipt of dividends on the money they have provided as capital. Thus it is often said that capital has become impersonal. It is an economic necessity that it should receive a fair and reasonable dividend, otherwise no shareholder would provide money, and an industry could not be inaugurated. It is from profits steadily accruing that fresh capital can

be saved for further investments and the expansion of industry. Furthermore, it is essential that fresh capital should become available for investment in houses, transport facilities, factories, and equipment to provide a means of existence for the yearly increase in population in Great Britain. This alone requires an annual influx of fresh capital probably exceeding £250,000,000. Profits on capital already invested in industry are, therefore, a prime necessity. Most of the economic and social progress of the past eighty years is identified with the development of this impersonal joint stock capital, organized into limited liability companies with the one object of earning profits.

4. EMPLOYERS' FEDERATIONS

The growth of an impersonal capitalism tended towards imposing severe economic pressure on the workers. They protected their own interests by forming trade unions. As the trade unions increased in membership and strength the balance of power shifted to their side. Individual employers lost a chance of success when disputes arose with their workers, regardless of which side was in the right. Consequently a movement was set going to consolidate employers into federations, and to-day some of these combinations of employers are very powerful. The Federations of Shipbuilders, Engineering Employers, Master Printers, Master Builders, the Mining Association, to mention only a few, are very well known as wielding great industrial power. It may be stated that the main purpose of most of these federations of employers is to offer an opposing front to the trade unions. With them they make agreements, while most strikes and lockouts are

economic fights between the two sides after they have failed to agree.

Employers' federations possess other useful powers. They can often exert pressure on a bad employer—*i.e.* an employer who seeks an unfair advantage over other employers in the same line of business by paying his workers lower wages or working them longer hours than standard conditions in the trade. In this and in other ways the federations as well as trade unions have done much useful constructive work in the past twenty-five years. Employers organized into federations have welcomed the existence of trade unions, for it is simple to discuss matters with a few leaders compared with the difficulties of settling anything at all with an unorganized crowd. Besides, the employer wants to arrive at agreements which are binding on his men, so that he may enjoy a period of stability.

5. CAPITAL

The round sum of one thousand pounds has been previously mentioned as an average amount of money which must be suitably invested to enable one worker to fill a niche in the industrial system, and earn sufficient to meet his personal needs. He will then be given an opportunity of earning at least a living wage in reasonable hours of work, and if he possesses industry and ability he will earn more. The capital investment per worker differs greatly among the industries, some requiring a much heavier initial outlay than others. The following figures are suggested estimates of the minima now required, not what was necessary in the past, when money was able to purchase much more than it can now. The figures exclude everything outside the industry itself,

such as housing, roads, transport, etc., all of which were previously included in the general and average estimate of £1,000 per worker.

Industry	*Investment per man employed*
Railways (excluding those underground)	£3,000
Water works	£600
Electric Light and Power	
Gas works	£400
Mechanical Engineering	£250
Shipbuilding	
Cotton Trade	
Coal, Iron, and Steel Trades	

It will be noted that the lowest investments are required in the manufacturing industries. A productive unit must provide output to pay wages, management expenses, and an interest on the capital invested. Wherever an industry can be operated so that the equipment, such as a railway, or a Fourdrinier paper machine (described in Chapter II.), or a sugar refinery, or other plant, can go on working during the twenty-four hours, then it is possible to spread the earning of the dividend and managerial expenses over this long period. It causes them to be much less on each eight-hour shift than if only one shift a day is worked. British engineering works, with their costly equipment, usually work only one shift a day. On the contrary, foreign plants of similar character often operate two shifts in the twenty-four hours. This enables higher wages to be paid simply because the proportion of income required by capital and management is so much reduced.

Many arrangements have been suggested to deal with this aspect of the problem, and hundreds of works

operate a two-shift sixteen hours day. The first shift will work from 6 a.m. to 2 p.m., and the second from 2 p.m. to 10 p.m., each getting a meal interval of half an hour. This makes $7\frac{1}{2}$ hours' work each day, but on Saturdays the works close at noon. The workers work alternately morning and afternoon a week at a time. So, one week working in the mornings they do $43\frac{1}{2}$ hours, and the second week working in the afternoon they do $37\frac{1}{2}$ hours. The machinery runs 81 hours a week. Such a method of operating means that the plant can earn its standing charges on a double output and double wages. The system has many variations, and economically it is of very great importance.

6. ADMINISTRATION OF INDUSTRY

It has been seen how shareholders provide capital, and elect from among their number a board of directors to assume the control on their behalf. The directors do what their title implies, they direct the business. They decide such matters as :

(*a*) The general policy of the company.

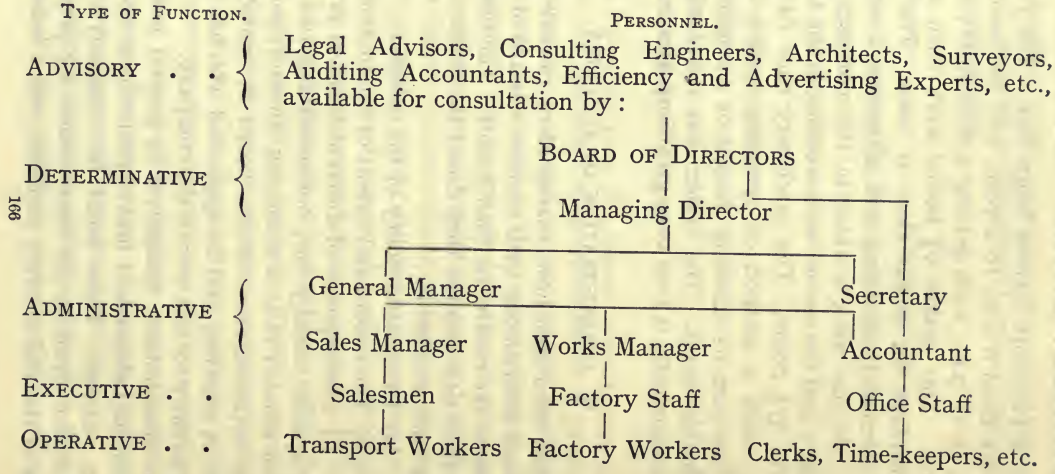
(*b*) The nature and extent of production.

(*c*) The sequence of different kinds of production.

They appoint usually one, but sometimes two or more, of their number to be a managing director, and he acts as the representative of the board in controlling the staff. A secretary will be appointed who has to accept legal liability for the acts of the company.

The shareholders themselves in general meeting will appoint an independent firm of professional accountants to be auditors. These audit the company's accounts and report direct to the shareholders by preparing for them at the end of every financial year a balance sheet

FIG. 1.—STAFF FUNCTIONS IN A MANUFACTURING COMPANY.



of the company's affairs. In this way the shareholders obtain a direct check on all transactions authorized by the board of directors.

A board of directors may engage a number of men to advise them, such as legal advisors, doctors, architects, consulting engineers, surveyors, efficiency or advertising experts, and others. Such men are usually of a professional standing, and they render advisory services sometimes of very great value and importance.

The managing director will generally direct both the secretary (who, however, always remains liable to the board as a whole) and the general manager. The two latter are the chief administrative officers of the company. Their duties are :

(*a*) To organize the whole executive staff.
(*b*) To co-ordinate all the different departments internally.
(*c*) To arrange for the continuous operation of the factory plant and the employment of workers.
(*d*) To preserve industrial continuity and settle disputes.
(*e*) To control the rate of output and manufacturing costs.

The table, Fig. 1, sets out the nature of the duties just described.

7. MANAGEMENT

The success of an industrial establishment is chiefly due to wise management, and this depends on the character and ability of the men directing it. Upon management devolves the duty of selecting the right man to fit each position. This is much more difficult than it appears, and requires considerable ability. Andrew Carnegie was a man who possessed such ability

in an unusual degree. He wrote his own epitaph for his tombstone in Sleepy Hollow cemetery thus :

HERE LIES A MAN
WHO KNEW HOW TO ENLIST
IN HIS SERVICE
BETTER MEN THAN HIMSELF

He probably meant better for each particular job than he was himself.

Now a wise management thinks highly of all its workers. Whether trusted with great responsibility or performing humble duties, they all should be treated with a broad human friendliness. Though none are indispensable they are all essential to the business. This attitude leads to harmony and success. Nobody should be thought of as inconsequential, readily hired, easily fired. That path leads to labour difficulties, lack of loyalty, and business failure. Co-operation throughout a staff is developed by management of the right kind. In fact, the best leader or manager is he who can develop the most pronounced co-operation and the strongest team spirit. The French call it *esprit de corps*. It cannot be defined, but is one of the virtues of success.

Management must know how to delegate authority, for the man at the head of a large industrial unit is managing many different types of activity, each with its own executive and assistants. Not only must he delegate authority, but he must be so trained and disposed that he can do this effectively, depending upon his chosen subordinates to secure the desired results. The larger the enterprise the bigger the number of them filling important positions. To exert authority, or manage in the true sense, becomes more difficult as the

authority increases in importance. The scale of difficulty moves upwards as the amount and character of the responsibility increases. To direct ten foremen, each at the head of a gang of ten men, is a somewhat difficult and responsible position. To direct ten superintendents, each at the head of ten foremen, each with ten men under him, is altogether more difficult, and involves acceptance of much greater responsibility. As the scale rises men of the right kind, right by disposition, experience, training, and ability, become more rare.

Chapter XII

DETAILED FACTORY ORGANIZATION

Scientific Management.

I. SYSTEMATIC ORGANIZATION

THE broad human relations in the management of an industrial staff were mentioned in the last chapter. These must persist whatever changes may take place in industry. The next important step is to realize how a proper organization will express these relations, and exert a scientific and methodic control. The aim is to obtain complete co-operation by defining and making clear everyone's position and duties, and co-ordinating all into one reasonable and collective plan. Much study has been devoted to enunciate this idea in definite working principles, for the guidance of all engaged in industry, whether specially gifted with organizing abilities or not. The object has been to enable men who may not be specially gifted with organizing abilities, a somewhat rare endowment, to arrange the allocation of duties among a staff according to rule. A remarkable general improvement in methods has followed.

It must be obvious that the detailed organization and the methods of management must vary widely from one industry to another. A preliminary glance at the working of a productive engineering plant was obtained in Chapter III. It presented an outline of the delegation of responsibility, and the division of duties and work, from

the general manager through his departmental chiefs to superintendents, foremen, and workers. Engineering production is a complex industry, and the organization is refined. So is printing, and the speed achieved in newspaper production is only obtained by a most rigid adherence to system. Other industries may have much simpler organizations. Consequently, details will differ considerably in different factories. At the same time general principles are useful for all. It is now intended to explain such general principles, and to illustrate their application by the actual method employed in engineering production.

2. SIMPLE LINE ORGANIZATION

Probably the military type of organization was the earliest ever used. Each soldier looked to his officer, who received orders from some other officer higher up, and so on in a direct line to the general commanding the army. Applied to industry it works out according to Diagram No. 2. Every worker takes his instructions from his own foreman, and the line of authority ascends stage by stage to the general manager. Each foreman is entirely independent of other foremen. Co-operation between them need not exist, and if it does it is purely a matter of courtesy. Likewise all officials on any one level of authority are independent of each other. This is line organization. The theory behind it is that authority, responsibility, knowledge, wisdom, and judgment reside primarily in the chief of the executive staff, and that orders go directly from him through sub-executives to subordinates.

If a little thought is given to the position in the factory, it will be evident that when each foreman is entirely

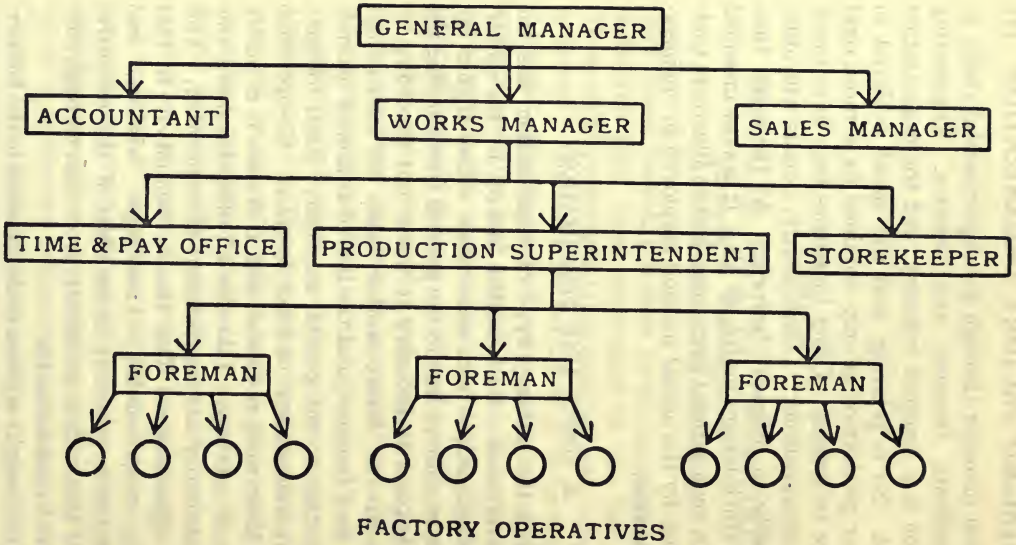


FIG. 2.—Diagram of a simple Line Organization.

independent he must himself perform a considerable number of different functions. Among these there will be the following duties:

(*a*) Engage his own men, supervise them as they work, preserve discipline, and discharge those unsuitable or no longer required. He must know where and how to find the best man for each position under his supervision.

(*b*) Superintend their supplies of material. He must foresee what each worker will require, and obtain the right material from the stores.

(*c*) Distribute correct instructions about the work. These may include plans and drawings, patterns, specifications, and so on.

(*d*) Fix wage rates, piece-work prices, or bonus schedules, and keep records of time and cost.

(*e*) Get for them the right tools, and set and keep the machine tools in good order.

(*f*) Correct, check, and inspect the work done. It will be his duty to see that each man does his work in the proper way, and obtains accurate results.

A number of other duties might be added. As industrial production becomes more complicated, the more numerous these duties are likely to be. Now men who are loaded with a great variety of duties, even if they are very able men, must tend to become inefficient. Some duties will be neglected. Should the foreman be ill supervision will suffer still more, and production from his particular group of men may completely break down. While it must be admitted that the line system provides the best disciplinary control, embodying as it does the primitive idea of the best way

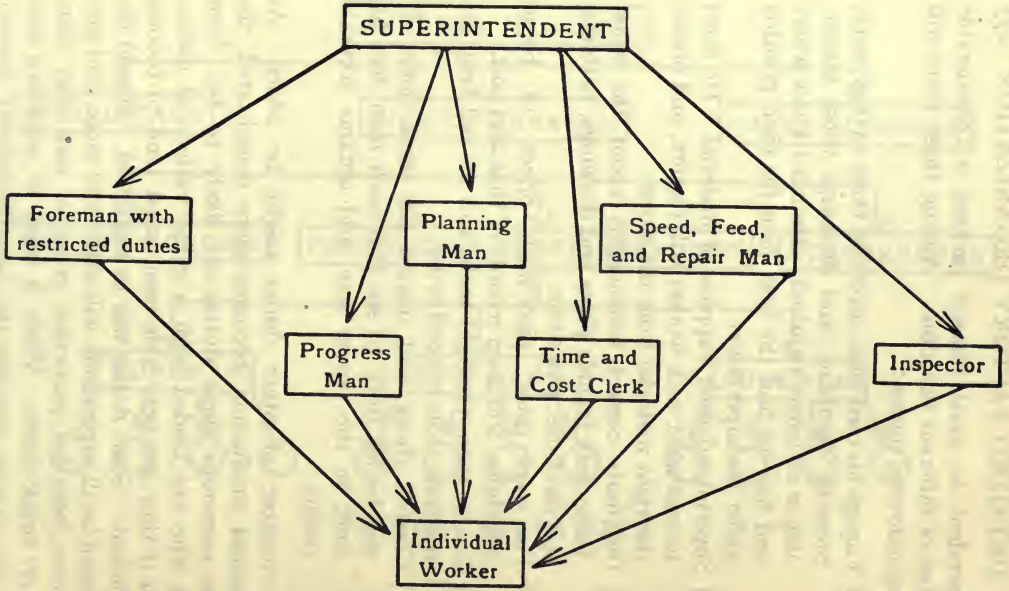


FIG. 3.—Diagram of the Functional Organization of Foremen.

of promoting authority and obedience, yet it is evident that it possesses some defects.

3. FUNCTIONAL ORGANIZATION

A second idea has been introduced into systematic organization to modify these defects. The pressure of so many varied duties is removed from one man by distributing them between several men, who must co-operate. Instead of each foreman performing all those functions mentioned above, he is limited to one duty, that of taking charge of the worker. He must give his sole attention to the supervision of his men as they work. He will give orders, and it is his duty to see that the orders are correctly appreciated and properly carried out. The right to dismiss a worker may remain vested in him, so that he may retain proper authority in the maintenance of discipline.

If the list of duties given in the last section is referred to, it will be seen that the foreman is now expected to carry out part or, perhaps, the whole of duty (*a*). The remainder are withdrawn from him, and each is concentrated in the hands of another man. Thus a group of foremen is created who may be termed special or functional foremen. All these have each his own duty, and form members of a team. All are of equal standing, and all must co-operate with each other, and with the original foreman. The latter is one of the team, and he must co-operate to so arrange the work that the best results can be obtained from the workers engaged in actual production. Each functional foreman is expected to act as the worker's guide, philosopher, and friend, rather than as his judge, jury, and lord high executioner. The idea is expressed in Diagram No. 3.

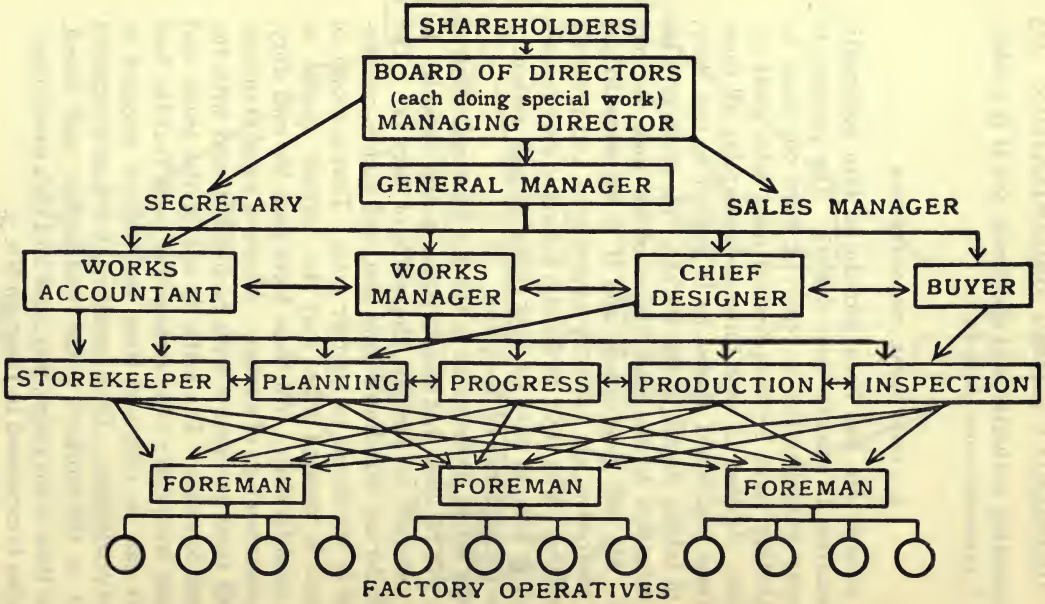


FIG. 4.—Diagram of a Line and Staff Organization.

In modern industry a division of duties is not confined to foremen, but applies to everyone in the scale of responsibility. Thus three directors of a manufacturing company might agree among themselves, one to be sales director, a second works director, and a third financial director. Each would take direct control of his special sphere, but all would co-operate in common council. A division of duties of this type is the regular rule, and the ways in which the principle is applied are innumerable.

4. LINE AND STAFF ORGANIZATION

In Great Britain a purely functional type of organization, developed from the theory just given, has never been carried very far, while the old-fashioned line organization, previously explained, is limited to small businesses. What is almost universally used in all production plants of any appreciable size is a combination of the two ideas; perhaps it may reasonably be termed a compromise between a rigid adoption of either idea. This is known as a Line and Staff Organization. Diagram No. 4 shows a practical working plan on this basis applied to the whole of an industrial organization. Examination of this plan will soon show how the line idea and the functional idea are interwoven. Every business that exists can be reduced to a plan of this type, though generally it would be more complicated than the example given.

The practical success which such a plan achieves will be due to the regard it has in arranging relations so that every man who is held responsible for the carrying through of certain work is given the maximum possible amount of control over all factors affecting his success. It has

been found by experience that different personalities and temperaments are more suitably fitted into a well-devised line and staff organization. Whenever overlapping does exist, and no plan can possibly avoid it, then working arrangements are always made for the staff concerned to meet at small conferences to settle knotty points by discussion. This, then, explains how all business organizations are so adapted to their staffs that the utmost co-operation may flourish, for on this factor is built up successful production.

5. THE WORK OF F. W. TAYLOR

In 1903 there was published in the *Proceedings of the American Society of Mechanical Engineers*, Vol. 28, a paper entitled "Shop Management," written by the late F. W. Taylor. This paper is regarded as the source of all modern ideas of scientific management. It marks the definite division between the practice of producing articles by workmen according to their own craft usages, and the new procedure by which all the resources of science and progress are placed at the disposal of the workers as they actually carry out their separate tasks.

Now the pioneer work done by Taylor, and the later development of his teaching and practice by other workers in the field of scientific management, together form so bulky an addition to present-day knowledge that it is impossible to do more than touch briefly the fundamentals of the subject in this book. It must be remembered that the principles first enunciated by Taylor are of universal application.

Taylor himself possessed a very interesting personal character. He was intended for a college career, but

a change of personal circumstances suddenly compelled him to turn to labouring in the Midvale Steel Works in Philadelphia in 1878. Proving to be an honest labourer he was made a clerk, then a turner on a lathe, and soon he found himself promoted to be foreman of the turning shop. He went up a step in an old-fashioned line type of organization for the same reasons nine out of ten men earn promotion, namely, because he was industrious enough to produce a little more work than his fellow-workers, and because he possessed more than the average workman's force of character. That particular shop had been on piece work for years, and it was the accepted practice among the operatives to practise a rigid restriction of output. In fact, every day they did about one-third of a good day's work.

Taylor as foreman set about to alter this state of affairs. He and the men quarrelled, and as he tried to force the pace, they tried every dodge, even that of breaking the machines, on the pretext they were driven too hard. Taylor possessed a strong character, was supported by his chiefs, and ultimately he changed the whole method of management. The principles he introduced are now practised everywhere.

6. THE ESSENTIALS OF TAYLORISM

Taylor set out to analyse the miscellaneous collection of duties usually bundled over indiscriminately to the foreman, as explained in Section 2. He desired to find a more scientific method of getting them done. He found that the duties could be divided into two main divisions, involving either mental labour or manual labour. The mental may be termed "planning functions," the manual "performance or executive func-

tions." He further analysed both of these and subdivided each into four functions, making eight altogether, as follows :

Planning. Four Functional Foremen.

(1) Order-of-Work Clerk, who routes material through the various processes.
(2) Instruction Card-writer, who fills in details as to the speed a machine should work, the tools to be used, etc.
(3) Time and Cost Clerk, who makes up the pay-roll and determines costs.
(4) Shop Disciplinarian, who deals with disputes and keeps order.

Performance. Four Functional Foremen.

(5) The Gang Boss, who receives the instruction cards, starts the workers, teaches them, and obtains output from them. He is the lineal descendant of the old foreman.
(6) The Speed Boss, who sees that the machine is run at the speeds called for on the instruction cards.
(7) The Repair Boss, who keeps the machine and tools in repair.
(8) The Inspector, who has jurisdiction over the process methods and the quality of the finished product.

Each function Taylor placed in the hands of a separate foreman, who became a functional foreman or, in his own words, a functional boss. This, then, was the origin of functional organization, which has already been briefly outlined in Section 3. It was Taylor's invention.

The main object behind this was really to ensure that the best work was got out of every worker and every machine. Further, it was desired to ascertain the one best way to perform a certain operation with the one best tool. This, it was thought, would result in the attainment of a high wage standard coupled with the lowest cost of production. The principles have been adopted whole-heartedly in America, and developed so that they are suited to everyday factory use. It is true to say that the American workman often produces three or four times what a similar worker here does, generally because of scientific management, and because his efforts are more efficiently directed, and machinery is run to its full capacity. The worker there agrees with efficient management, and he is the highest paid in the world. Yet his production is often extraordinarily cheap. The Ford car and the Waltham watches are well-known examples of this. The low price is not the result of low wages, nor could production ever have been developed had the workmen themselves obstructed efforts to eliminate wasteful methods of working and to increase efficiency.

7. TIME AND MOTION STUDIES

All methods of paying a premium bonus depend on a standard time being fixed for completing each piece of work. The operator earns his bonus on the time he saves. Time study is the preliminary investigation into the time required, either by practical test, or else by consideration of predetermined data. The facts are ascertained by some reliable method, which will enable the planning department to fix for shop production a time fair to an average worker. The object is to utilize scientific method and management in arranging pro-

cesses instead of simply leaving this factor of production to haphazard workshop method.

Time study was invented by F. W. Taylor. The idea he introduced was to analyse ordinary workshop operations into their constituent elements, and to experiment until the one best way to perform each of them was devised. By scientific method and management it is possible to arrange processes beforehand, and to reduce the decisions to definite written instructions given to each worker, thus eliminating any uncertainty in manufacturing procedure.

When studying the time required to complete a particular piece of work it becomes apparent that the least time is always taken when the best method is used. This best method is the one that involves the least amount of work. So the investigation becomes a matter of eliminating all superfluous and unnecessary work. Hence there has been a desire to watch for and detect all superfluous motions, so that labour of this kind can be eliminated. Dr. Gilbreth, an American efficiency engineer who has further developed the methods of F. W. Taylor, has been closely associated with motion study. An example of how he has worked will make the matter clear. One of his earliest detailed studies was applied to ordinary bricklaying, and, though this is one of the oldest crafts, he was able to prove its inefficiency in a remarkable way. By arranging that bricks were delivered to a man on the same level as the place where they had to be built into a structure, instead of being put on the floor and the man therefore compelled to lift up each one and then place it into position, and by other simple rearrangements of work, he showed the bricklayers how they could reduce the number of movements made in handling and laying a brick from eighteen to

five. Thereupon it was found that a man could lay three times the number each day without suffering greater fatigue.

Motion study has now progressed far beyond the simple example just outlined. Investigations have been effected by fastening to a man's hand an electric lamp, which, as it moves about in working, is photographed. The photograph will show bright lines defining the exact movements made. By modifying movements and procedure the best way to do the work can be evolved. The cinema has also been used in this connection, and if a large clock face is included when taking the picture it is possible to ascertain the exact time taken for each separate movement and process.

By proper time and motion investigations, and the determination of the one best way to do any particular piece of work, a direct gain in output often follows. This leads in due course to improved conditions, higher wages, and shorter working hours. It is indeed only by improving production that these advantages can be obtained. So scientific management and the detailed study of improved efficiency, following upon the original conception of the one best way, have all provided a great stimulus to industrial production.

Chapter XIII

PLANNING: PROGRESS: PRODUCTION

I. THE PLANNING DEPARTMENT

EVERYONE plans events or programmes in advance; it is an ordinary proceeding in the simple everyday affairs of life. In activities which are unusually complex, such as most manufacturing processes, planning assumes fundamental importance. Planning of production occurs at every stage, and is completed before the work gets into the workshops. In a complete sense it involves four definite ideas:

(*a*) Planning what article shall be made.

(*b*) Planning how it shall be made, or designing the article and manufacturing equipment.

(*c*) Planning where the work shall be done—*i.e.* arranging the manufacturing processes.

(*d*) Planning the order in which the work shall be done, or predetermining the entire sequence of manufacturing operations.

Now the question what is to be made is usually decided by the controlling principals of a business. They know the needs of the market and the trend of demand, or they receive definite instructions from clients.

Designing the article to be produced and the factory equipment is relegated to experts, designers, draftsmen, and others. Having received instructions from their

principals, they complete the designs with full consideration for the capacity and equipment of the factory and the nature of the staff.

The third and fourth steps, which comprise planning the manufacturing processes and predetermining the entire sequence of manufacturing operations, become the duties of a special department in the works, known as the planning department. This is the accepted British practice, and it should be realized that the planning department is limited to the particular work of planning the manufacture in the factory. All the preceding steps, including the erection of the factory, determining the general equipment, and designing the article to be made, do not concern it.

Before proceeding to develop the detailed duties of the planning department, an effort can now be made to connect the British system with the work of F. W. Taylor. In the preceding chapter it was explained that he included all the foreman's mental duties under the term planning, which he further divided into four sections briefly described as :

(1) Settling the order of work.
(2) Drawing up instruction sheets.
(3) Controlling times and costs.
(4) Smoothing out disputes.

In British practice the planning department has not adopted this schedule, and its duties do not rigidly follow the above four ideas. Its details have developed along somewhat different lines, which are explained in the following paragraphs. Nevertheless, the credit of systematic shop organization, however much the details differ, must be given in full to F. W. Taylor.

2. DUTIES OF THE PLANNING DEPARTMENT

The planning department receives the design from the drawing office in the form of working drawings, and therefore it is not concerned with actual design. Where obvious defects or errors occur in these working drawings the matter is referred back to the designer for instructions. The essential duty of the department is to produce work in the shops according to the designs and instructions received. It is, therefore, an executive department.

The planner is expected to realize the function, or method of working, or use of the article to be made. He also starts with expert knowledge of the best processes of manufacture. The plant and equipment available and already installed in the factory has to be appreciated in regard to both capacity and limitations. He thinks out in detail, step by step, how each item is to be made. Definite sequences of operations as well as the detail of all methods are settled. Thus is fixed the route to be followed by every piece of work as it passes from one machine process, in the hands of one operator, to a second, third, fourth, or more processes, each in the hands of other operators.

Having determined the best way to do each process in the manufacture of a piece of work, it next is necessary to fix a time for each constituent process. To these times are added allowances for intervals between processes, and in this way a total time for doing the piece of work is obtained. Sometimes such time allowances are determined by a practical experimental test. In other cases statistical records may be drawn upon. These will be preserved for reference in the planning office.

Further, the planner may find it necessary to initiate requirements for better or more suitable tools, which, in due course, will be designed in the drawing office, and made, perhaps, in the tool room of the works, or alternatively purchased outside. This form of a planner's activity may lead to the greatest changes in the method of production, and it will be obvious that such work is of the highest possible importance in industry. Any producing unit, as a motor-car works, a watch, or clock, or gramophone factory, is full of special purpose tools and machines, which orginated in this way.

A planner must possess considerable knowledge and ability if he is to carry out the above duties satisfactorily. He will most likely have obtained his experience in actual production. Many different branches of knowledge are required, and the high-grade character of the experience and ability demanded are tending to cause subdivision of the responsibilities, and specialization in the range of duties of a planner. To be an expert in all the operations carried on in a large manufacturing plant is demanding rather too much of any one man.

3. THE INSTRUCTION SHEET

Without entering into all the ultimate details of planning operations, which could hardly be done properly if the whole of this volume were devoted to it, the planner writes out the sequence of operations which he devises for making an article on an instruction sheet, and opposite each operation or stage in the process of manufacture he specifies the time allowed for its completion. The instructions include routing the item from process to process through the shops. This instruction sheet, along with a working drawing, includes absolutely every

necessary technical instruction to the foreman and to the worker who has to undertake the work.

It will be remembered that under the old system the foreman only received outlined instructions, and he was expected to carry the responsibility of explaining and detailing everything to his men. He carried too much responsibility. Scientific planning provides that each order that reaches a foreman will be accompanied by its appropriate drawings, detailed instructions covering the sequence of operations, time allowance, and particulars of the actual machine tool to be used, material withdrawal notes, along with notes on small tools, jigs, and fixtures to be used. The foreman selects the operator to work a machine, but the job to be done on it is now selected by the planning department.

When a premium bonus system is in operation every operator receives with his instruction sheet a premium card. The use of this is to obtain a record of time taken to complete the work as compared with the standard time fixed by a planner and entered on the instruction sheet. Sometimes the preparation of the premium cards is the duty of the planners, often it is left to the production department, and is then looked after by a group of men known as controllers. This is a matter of internal organization. The calculation of the actual premiums earned may be left to the time-keeping clerks. Queries sometimes arise among the men on production regarding the correctness of instructions and times, and a shop superintendent will keep these under adequate control by his own close personal touch with the planning official. It is essential that co-operation of this character should be complete.

4. RATE FIXING

A brief outline of the ideas involved in investigating the time it takes to complete certain work was given in Chapter XII., Section 7, in connection with time and motion study. Wherever the payment of a premium bonus depends on the time taken by an operator compared with a standard time allowed, the matter of an accurate and fair determination of the latter assumes much importance. Such determination is usually termed rate fixing. The men responsible for it usually form a small and expert group in the planning department. On their work depends in a large measure the success of the premium bonus system in the factory.

Now the rate-fixing section in an engineering works is largely concerned with setting up standard times for the removal of waste metal by some machine tool. A study is demanded of the mechanical possibilities of machine tools, small tools, and materials, combined with the range of human dexterity. F. W. Taylor carried out very thorough researches in this field, and he has described all the mechanical variables involved in the problem. These matters are not suited for detailed treatment in the present volume, and readers who are interested can read them best in the original papers.

Production in large-scale manufacturing could never be developed unless the capacity and speed of the equipment units were well understood. The actual output obtainable cannot usually be calculated from data, but must be determined in a practical manner. In engineering and similar processes trained demonstrators can be utilized not only to set times, but to teach operators how best they can maintain a regular speed in output. In other kinds of work the standards set are usually the

results of past experience. Smelting times, heat treatment periods and temperatures are examples. In such industries as baking foodstuffs, bread, cakes, or biscuits, or other cooking processes, periods and temperatures are all scientifically controlled, and the potential output from new machines can be realized in the light of past experiences. New equipment which is to be laid down to ensure an output of a certain magnitude is calculated from close study of potential output. Thus it is evident that time study is bound up very closely with every kind of manufacturing activity.

5. THE PROGRESS DEPARTMENT

When the designers have completed the working drawings, and the planning department has prepared instruction sheets and premium bonus cards, all these go to the foremen who have to proceed with the work. In order to control the supply of materials to the foremen and workers, to watch and record the progress of operations in the shops, and to correlate the estimates of production prepared by the planning department with what actually happens, it is necessary to have a special set of officials, and these form the progress department. The progress men are the essential agents of co-operation in the factory. They bring about the necessary co-operation of foremen and workers with the stores, the planning department, and the management of the works. The idea is to get the work through the shops with minimum delay, and to foresee and prevent difficulties, and if they cannot all be prevented, then to smooth out those that do arise.

The progress staff are always watching the output of work, and they keep accurate and up-to-the-minute

records of all completed operations. They control the whole programme of production, from the receipt of material, throughout the manufacturing processes, up to the final delivery of the finished products. Statistics are recorded in a manner suited for instant reference by the works management staff, or others interested, and often the records are kept in the form of large charts, possibly supplemented by card indexes.

An important duty consists of so recording the essential facts of the production that superintendents and managers have available at any moment sufficient information for them to judge exactly what is happening throughout the works. A failure of output may arise from causes which have very different origins. Certain material may not be received in time ; machines may break down unexpectedly ; workers may be prevented from attending ; the number of workers or equipment in different sections of the factory may not be properly balanced. All these difficulties are brought to light by the assiduous and watchful care of the progress staff.

6. THE PRODUCTION OR MANUFACTURING DEPARTMENT

The works manager divides his factory organization into the departments of planning and progress, which have been described, and the actual production or manufacturing department, whose work is examined by the inspection department. The production department proper consists of officials such as assistant works managers, shop superintendents, and head foremen, along with the staff of foremen, charge hands, and actual operators. The foreman is the executive official in the workshop, and every operator engaged on production is

in the charge of one of the foremen, who generally possess a power of suspending or dismissing those who prove incompetent or unsatisfactory. The idea which has usually been accepted in industry is that the authority of a foreman must be supported by delegating to him such personal power over his men. In some instances the supreme power of dismissing a worker has been modified by other arrangements, but in any case he must be consulted when new workers are engaged, and when suspensions or dismissals are necessary.

The foreman is provided with information from the various departments already described. The drawing office supplies him with working drawings and specifications. The planning department prepares the scheme of manufacturing, and issues the instruction and premium bonus cards. The progress department controls the issue of these in the correct order of urgency, and arranges the progress of the work in a general way. When the work has been done by the workers under the immediate control of the foreman, another department, that of inspection, which will shortly be described, examines the work. The above scheme fixes the exact position of the foreman in the scheme of production.

It will be remembered that F. W. Taylor first analysed the foreman's responsibilities, and discovered a method of arranging the active or production functions of the foreman under four divisions. In Chapter XII., Section 6, has been given the full list of Taylor's functional foremen. Now it would never be a workable system for several men to undertake the control of workers. It would lead to a clash of personalities. So in Great Britain the shop foreman takes charge of the workers placed under his control, and the departments which initiate, control, and check the production issue their

instructions to the foremen, and not direct to the operators.

7. THE DUTIES OF FOREMEN

A well-known American authority on scientific management, Dr. Gilbreth, has provided a list of foreman's duties in which he sets out in detail no less than forty items. These can be condensed briefly into four main heads. He must

(1) Possess skill as a worker.
(2) Know how to exert authority and command respect.
(3) Be able to carry responsibility.
(4) Be able to understand a problem thoroughly.

A foreman is a unit in a systematic organization, and he must possess a thorough understanding of the system. He must also know how to perform the operations in his department, and be able to show any worker the proper way to do his job. He should understand his men, their mentality, degrees of competency, and characteristics. This all-round knowledge is usually gained by hard practical experience in the workshop and by study. The supervision and teaching of his men is his particular sphere. He has to maintain a high standard of production and efficiency, and he is ultimately responsible for the real discipline in the factory. He generally has earned his promotion from the ranks, and this is much the best method, since it gives each ambitious worker something to strive for as well as ensuring that the foreman understands the difficulties of the worker. Promotion to foremanship is generally the first step to higher and more responsible positions.

A foreman is paid a salary, so much a week. Sometimes there is added a special production bonus to en-

courage him to seek the most efficient methods of production. It is advisable that all foremen should be directly interested in improving production, reducing labour costs, and economizing materials.

Usually it is considered advisable that a foreman should not be a member of a trade union. The federated engineering employers require all foremen to resign the union membership and join the foremen's association. This is a wise precaution, for it is perfectly certain that no man can serve his employer to the best advantage if he has at the same time to accept orders from the executive officials of a trade union. Some trade unions have attempted to enforce membership of their union on all foremen, and the issue has been regarded as of fundamental importance by both sides. At present the accepted practice is that membership of a trade union shall not be held by a foreman.

8. THE FOREMAN'S INFLUENCE ON HIS MEN

So much for the dry bones of how a foreman manages his men. There is, however, something much deeper. He must observe, guide, and teach human beings. The main problem in any factory is human nature, and at no point is this so pronounced as in the contact between the foreman and his men. The development of scientific management is less in importance than this rock-bottom problem of handling men. "Can he handle men?" is the question that the manager wants answered about a prospective foreman. A leader of men treats men as men. Foremen are the finger-tips with which the body of management touches the workers. Very nearly everything in industry turns on that touch. Men respond to sympathy and fellow-feeling. Industry

consists of the actions of men; is, in fact, men, not machines, in action, helped along by machinery and power. The factory exacts hand craft and brain craft, and the way to do this most efficiently is through the broad fellowship of men engaged together for mutual advancement. A clever efficiency engineer, Mr. H. N. Casson, has given the following "Ten Rules for Foremen," which are worthy of recording here:

(1) Be fair—have no favourites.
(2) Make few promises and keep them.
(3) Don't waste your anger—use it.
(4) Always hear the other side.
(5) Don't hold spite—forgive.
(6) Never show discouragement.
(7) Notice good work as well as bad.
(8) Watch for aptitudes.
(9) Be an optimist.
(10) Take your full share of the blame.

Chapter XIV

INSPECTION: STANDARDS: STOREKEEPING: RESEARCH

I. THE INSPECTION DEPARTMENT

INSPECTION is the expert examination applied continuously during the production of any article. Raw material purchased outside is examined and passed before it is accepted and taken into stock. Then onwards, at every single stage in manufacture, a close watch is kept to see that dimensions, strength, weight, and any other specified qualities are correct. Finally, the finished article passes its tests before being handed over for sale. All this testing and examination is generally carried out by a group of men who form the inspection department. The duties of this special staff constitute a complete technical check on the work of everyone else. Hence the inspection department is established on an independent basis, and usually derives its authority immediately from the works manager.

No subordinate in a works organization is allowed to overrule a decision made by an inspector, and should a dispute arise, it is referred directly through the chief of the department to the works manager. The delegation of authority is usually arranged on a line basis, and one arrangement that may be used is shown in Diagram No. 5.

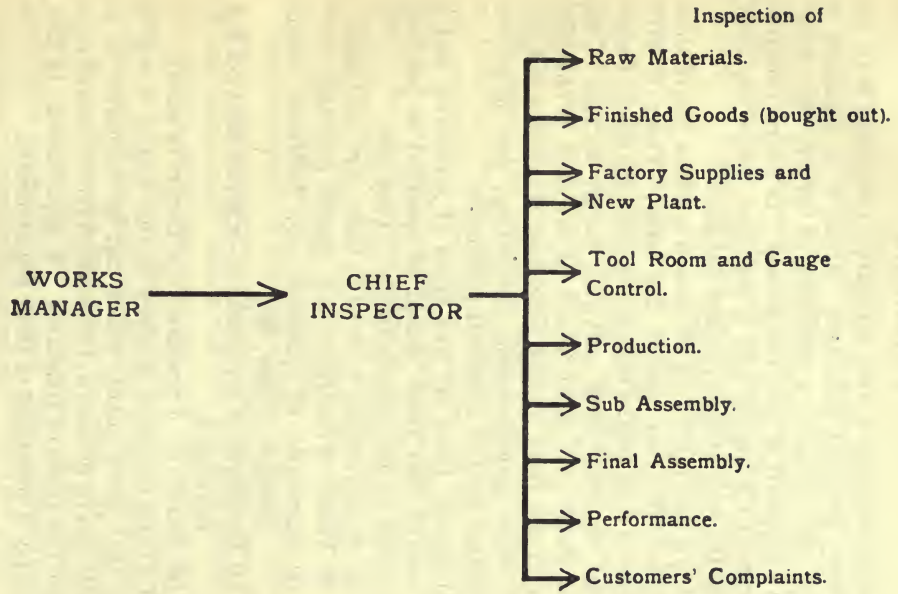


FIG. 5.—Inspection Organization Chart.

2. STANDARDS

Manufacturing is very intimately concerned with the primary physical standards. There is a standard of mass, the pound; a standard of length, the yard; and a standard of time, one second. In metric countries a standard kilogram and a standard metre are used, while the unit of time remains the same.

It is a nice matter for discussion whether one of these systems will ever absorb the other. There is little chance of it as long as both systems are the basis of widespread manufacturing activities, simply because of the incalculable cost which would be involved in changing over to new tools, gauges, machines, scales and weights, and other manufacturing, measuring, and inspection apparatus used in industrial production.

Altogether there are five types of standards, and it is essential that these should be specified as precisely as possible to aid manufacturing. They are:

(*a*) Measurements referred to mass, size, and time.
(*b*) Values of constants—*e.g.* specific gravities.
(*c*) Standards of qualities—*e.g.* hardness, tensile strength, colour, etc.
(*d*) Standards of performance—*e.g.* fuel used per h.p. developed.
(*e*) Standards of practice—*e.g.* factors of safety.

If a little reflection is given to this matter it will be seen that every quality which can be attributed to an article can be defined in terms which refer to one or more of the five types of standards. A specification, in fact, is simply a statement of these requirements.

3. TESTING A DIMENSION

The function of inspecting any article connotes the existence of a standard article, or a specification, against which a comparison can be made. Before inspection can be effected there must be formulated a clear conception of the standard. This may be a simple matter. For example, a dimension can be specified that it must be one inch in size. Now absolute exactness cannot be achieved by anyone, so, in addition to stating that a size is to be one inch, there must be added a further statement as to the " tolerance " which will be allowed—that is, how much more or less than one inch is to be allowed. This may be one-thousandth of an inch on either side. The tolerance then is two-thousandths of an inch, and the size must be neither less than .999 inch nor greater than 1.001 inch. These are the "limits." This is a perfectly straightforward and simple specification. An operator can follow it, and the inspector can check his work. Any piece he makes which is smaller than the minimum or larger than the maximum size allowed is rejected by the inspector.

Suppose now that this size applies to the diameter of a hole. The inspector will have two gauges, consisting of two plugs, one of which will just slip into a hole .999 in., and the other will only slip in if the hole is greater than 1.001 in. The inspector takes hold of a piece he is testing, and if the small gauge goes in and the large does not go in, then the hole must be right. If the small refuses to go in, the hole is too small ; if the large does go in, then the hole is too large. This is a typical simple example of dimensional gauging. The two plugs will probably be made, one at each end of a handle, and this is known as a " limit gauge."

Although the above is a simple explanation of what an engineer may mean by saying that a hole must be one inch in diameter, yet it is nothing more than a very elementary statement of the problem. It has been discussed for many years past whether a one-inch hole should be allowed limits on both sides of the ideal size or only on one side. It is a matter of unilateral or bilateral tolerance; but though this subject is of great interest, it cannot be pursued further here.

4. INDUSTRIAL STANDARDIZATION

The progress of standardization is another of the remarkable efforts in the industrial field which has originated in England. Sir Joseph Whitworth began by substituting Whitworth standard screw threads in the place of the screws of all sizes and shapes then in common use. At the beginning of the present century Sir John Wolfe Barry formed the Engineering Standards Committee to specify standard sizes of steel rail and girder sections. During the intervening years the growth of the British Engineering Standards Association (B.E.S.A., as it is known for short) has been so remarkable that it has excited the wonder and admiration of all those interested in industrial progress throughout the world.

At first standardization confined itself to sizes, shape, and quality of material, so as to secure interchangeability. In simple language, it was considered imperative that, say, any half-inch nut, wherever made, should be a good fit on any half-inch bolt. This was what Whitworth accomplished. The B.E.S.A. applied itself to reducing all the common materials of engineering to standards, and so great have their labours been that nearly 250 reports have been published specifying particulars of a

multitude of ordinary materials. Take as one example ordinary steel rails used on the light railway tracks in mines. It is said that there were more than 500 types of these in use. By standardization, selecting the best, and eliminating all those whose variations were of no importance, there have been left fourteen standards, which cover every need. Now the production of steel rails requires an expensive rolling plant. Obviously it must greatly cheapen manufacture if makers are called on only to produce large quantities of a few standard sections, rather than smaller quantities in a great diversity of sizes and types, each of which will be the subject of a special order, and consequently will not usually be made in large quantities and kept in stock.

The economy resulting from this great industrial movement has now been appreciated by the various Governments of the Empire, and it has become a subject for consideration and investigation by the British Imperial Conference. The limitation of both manufacturing and usage to standard articles leads to a huge saving to the community. An example often quoted is that of electric lamps. For every difference in voltage of electrical supply a different series of lamps has to be made and stocked by the manufacturer and by the dealers. There is no virtue in such differences of voltage as have existed for years even in London; it happens that they have developed in this way. It leads to a great deal of money being locked up in miscellaneous stocks of lamps. Reduce the voltages to a common standard, say either 100 volts or 200 volts, and immediately it is possible to dispense with lamps of all intermediate voltages, leading to a simplification of trade and to the financial benefit of all. The close study of standardization now inaugurated by the Imperial Conference will

lead to definite co-ordination of the efforts hitherto made by private manufacturers in England, right through the Empire, and forge another link in general prosperity.

5. STOREKEEPING

The cost of manufactured goods depends somewhat on the efficiency of the control and administration of stores and stocks. Usually the former word " stores " is restricted to mean the raw materials purchased by a factory to be transformed by its manufacturing processes, while " stocks " will describe all the finished goods, as well as those finished components and tools purchased outside. This is an arbitrary difference, but is useful in practice. Some industries require raw materials to be purchased and stored on an extensive scale. Gas companies usually have a very large store of coal, and further instances will readily come to mind. In other industries the store of raw materials may be quite small, while the stock of finished goods may be very valuable; for example, a business making electric lamps may work on such lines, and keep large numbers of all kinds of finished lamps in its stockrooms ready for sale.

The storage of raw materials and partially and completely finished products is in the charge of the storekeeper. He is responsible for their safe keeping, and before he issues anything he requires in exchange a proper requisition form signed by an authorized official. Systems of storekeeping are always interlocked with the accountant's department, which investigates costs. The cost of manufacturing an article in the works consists of several distinct items, one being wages, another materials, another supervision, and so on. Hence the importance of high-grade storekeeping methods. The chief store-

keeper in a big works may have in his charge articles worth a very great deal of money, and his position entails considerable responsibility.

6. THEORY OF STORING

It is usually most profitable if a factory can be kept in operation without interruption, and a uniform rate of production maintained. To ensure this there must be available a supply of everything required in unbroken continuity, and this is usually obtained by keeping adequate stores of materials. The surplus output made in the dead season, should there be one, is put into stock to be sold when buying activity sets in. Hence it is the rule to instruct the storekeeper what is the minimum stock of each item he must have always available, so that he can keep his store bins replenished.

A second object in storing goods is to obtain an advantage in the purchase price by buying large quantities occasionally rather than smaller quantities often. Again, the fluctuations in price of raw material often enable a bargain to be struck at a time when demand is poor. Some goods fluctuate regularly in price, but most of them irregularly : it is the minority that enjoy fixed prices.

There are certain disadvantages in storing all goods. The money they represent is not earning interest, but is locked up. Again, charges are being incurred for the space occupied and for insurance premiums, while they must be protected, which means an expense in wages and salaries. Almost everything deteriorates in quality the longer it is stored, and this leads to losses in value. The further risk of depreciation in market value is balanced by a possibility of appreciation. Hence it follows that the storing of materials and finished stock in all industrial

enterprises is governed by financial advantages and disadvantages. After these have been balanced it is left to the business judgment and acumen of the chief executive or the directorate to lay down a policy. Much depends on its success, for clever purchasing of supplies is often the one factor which can make a highly competitive business prosperous.

7. INDUSTRIAL RESEARCH

The value of pure scientific research is now widely appreciated. Its nature and scope vary much according to the subject of investigation. Industrial research is not quite the same thing, since it is primarily directed toward investigating what will become commercially profitable. The development of new processes and methods used often to be dependent upon the inventions of some genius who exploited his own work by founding a business, such, for example, as did Henry Bessemer in connection with his discoveries in steel-making. While industry has been growing much more complex, there has been a vast output of pure scientific research all over the world. It has proved necessary to concentrate efforts to collate all existing information, and to direct research under special groups of experts.

Large enterprises usually have their own research departments. Great solicitude for general advancement has been shown by the Government, which has founded the Department of Scientific and Industrial Research. This has organized the subject under industries, and there is mutual co-operation by all the firms interested. It must be remembered that there are two intellectual processes at work in this connection, invention and discovery. Invention usually arises from those engaged in

an industry and skilled in its technicalities. The results can be protected in patents. Discovery is mainly contributed by scientific workers in laboratories, and their results often become of great value commercially and in industry proper.

Chapter XV

WELFARE WORK: HYGIENE: MEDICAL SUPERVISION

I. WELFARE SUPERVISION

UNDER the term welfare there has been embodied a great volume of investigation, research, and voluntary effort, all having the sole object of educating and training each individual worker to take an intelligent interest in both his own and his fellow-workers' health and efficiency, and also in the industrial establishment of which he forms part. This does not mean that welfare confines itself to the provision of hygienic standards of accommodation, so many cubic feet of space, so much light and heat, just as the minimum requirements are specified in the Factory Acts. It is much more a matter of voluntary effort on the part of employers to improve, within the limits of the existing industrial system, the conditions of employment in factories. The well-being of men and women depends on satisfying both physiological and psychological requirements. The wages paid are intended to provide for the physiological requirements. Welfare work is directed to minister to the vaguer psychological desires. This often affects to a remarkable extent a worker's contentment and enjoyment of life. Each individual possesses a psychological character differently developed according to his per-

sonality, or education, or home surroundings, or other causes. Welfare work is not desirable for some, while it can supply to others a much needed want. This, then, is the fundamental character of welfare work.

2. WELFARE ORGANIZATION

It has been decided that a welfare plan in a works is best conducted through the medium of committees elected by the workers themselves, and representative of all classes of labour employed. Welfare must be kept apart from trade unionism; the two need never clash, because their objects as well as their methods differ appreciably. The directors or general manager sometimes appoint a special officer to supervise welfare arrangements, and the department is then somewhat distinct from others in a works. The supervisor will have a staff of assistants in a large factory, and their number will probably approach one for every two hundred boys employed, and one for every three hundred women and girls. In some of the most advanced and successful examples of modern welfare work the separate department idea has been superseded. The whole system has been incorporated into the regular factory organization.

Welfare has met with greater success among boys, girls, and women than among men. The latter are not so emotional, and their psychological needs and desire for friendly support in everyday affairs much less. It is helpful if the duties of the welfare department can be linked up in some tactful way with employing workers. It has been mentioned that the British system is to allow the foreman to control his men, and it is he who usually dismisses incompetents. In the past it has been assumed essential to uphold the authority of the fore-

man by not interfering with this right. There is, however, plenty of opportunity for a central employment office in a works to select suitable candidates for entry into the workrooms, especially where standards of knowledge and experience are not indispensable, while personal considerations of honesty, cleanliness, and other attributes assume a major importance.

3. WELFARE SUPERVISION FOR BOYS

The supervisor will interview parents and the boys who desire to come as apprentices, or learners, or for the general requirements of the factory. He may, perhaps, best regard himself, and insist on being so regarded by the boys, as *in loco parentis* as far as the factory is concerned. He will deal with the preliminary medical examination, with trial periods in the workshops, maintain close touch with the boys employed, keep a watchful eye on their progress, see that proper opportunities are afforded them for learning their trade, and look after their educational facilities. Their time-keeping, health, and promotion will be watched by him. Many firms not only give prizes to all their boys who make good progress, but spend considerable sums in training them to become skilled workers. The welfare supervisor will probably administer these. In addition he may give a friendly hand to help athletics and recreation.

In such ways he assumes a position in a works somewhat apart from the commercial necessities of the establishment. He often finds himself with real opportunities to guide the young industrial recruit along the path which leads to efficiency and promotion. The recruit himself is not the only one to gain, for it is only by the continual improvement of its man power in intelligence

and handicraft that British industry will continue to hold its own against fierce international rivalry.

4. WELFARE FOR WOMEN AND GIRLS

It is usually the duty of a lady welfare supervisor to influence the selection of a healthy staff of women workers. She may further be given sole authority to engage them, and even to deal with any necessary dismissals. Her other duties will fall into two classes, those inside the factory, and those concerned with matters outside. The nature of the industry must influence the scope of the welfare supervisor's duties. She will be expected to preserve a high standard of behaviour or tone among the women and girls, and, by personal contact with the workers, should be in a position to offer advice to the management regarding sectional transfers of workers and dismissals. The maintenance of proper standards in canteen supplies and attendance, and in such matter as ventilation, warmth, special clothing, caps, overalls, and so on, also in lavatory accommodation, will be part of her normal duties. Possibly to these will be added first aid and accident service, and the preservation of proper records. On the other hand, welfare is sometimes kept separate from medical work.

Those outside matters, normally quite beyond the control of the factory staff, yet which may be included in welfare, are much more difficult to describe. They may be matters of domestic embarrassment at home, which may, for example, lead to bad time-keeping or absenteeism, or it may be illness in the family circle, leading to lack of nourishment, and innumerable other difficulties. Welfare sometimes tends to become a matter of rendering social service.

5. INDUSTRIAL FATIGUE

The study of psychology has been mentioned as a subject within the province of welfare. In recent years there has been accorded to it a considerable amount of thought and research, especially by the Industrial Fatigue Research Board, supplemented, since 1921, by the voluntary organization, the National Institute of Industrial Psychology.

They have made the subject of industrial fatigue one of their main branches of study. Many of the simplest examples of this malady are known to all: the finger cramp that affects typists, writers, and telegraphists, and the nystagmus which sometimes afflicts miners. These arise from unvarying repetitive work throughout long periods. Generally, work involving repetition of the same movements is such that the complete cycle of activity is irregular and infrequently repeated. A tradesman repairing boots and shoes is an example of this. He goes on day after day soling, heeling, and patching, but he is never likely to suffer from technical industrial fatigue, because the muscular motions of his work are not regular, and the recurring cycles of similar operations are separated by considerable and variable time intervals. An appreciable degree of mental concentration and effort is required by this man in thinking out his procedure as he goes along.

Now turn to some other worker where the cycles are made shorter and repeated at regular intervals, such as a woman folding handkerchiefs all day long. She will be able, after a little practice, to do such work automatically with no appreciable mental effort. One complete cycle of operations is rapidly done and another follows at once. In other extreme cases the complete

cycle may be so abbreviated as to last only a few seconds, and the worker forced to keep going at a fixed pace to keep time with, say, the action of some machine. Many processes are of this character. The work gives rise to nervous fatigue, and ultimately both the efficiency of the worker and her vitality suffer. It is said that there happens a partial inhibition of the transmission of directions to the muscles from the controlling centre in the brain. The brain may be active and fresh, and the muscles willing to contract, but somewhere along the line of nervous communication there is a partial failure. Industrial fatigue originates in the nervous system rather than in the muscles. The subject is very interesting, but an adequate description cannot be given here.

6. VOCATIONAL GUIDANCE

It is somewhat seldom that a man may be found whose occupation is exactly what he himself would have wished and chosen. Most men have their work selected by some outside influence: the wish or caprice of a parent, the pressing need to earn a living, a chance meeting, or a casual talk. Should anyone begin to think that he has fallen into an unsuitable occupation, and this leads him to dislike it, then the work may become very distasteful. He may grow discontented, inefficient, and unhappy. Haphazard selection of a vocation is, without doubt, a mistake. Vocational guidance is a new procedure intended to assist children, as well as men and women, to select and fit themselves into a suitable occupation.

The interests of all workers, not less than their employers and the community generally, would be best served if the qualifications required in each trade or

calling were clearly recognized. Employers are well aware of the wastage entailed by having to teach unsuitable industrial recruits, while to the latter only disappointment and distress result from efforts to undertake any task beyond their powers. It would be advisable if children, at the age when they pass from educational institutions to industrial life, could be examined by specially trained and qualified men or women, and placed in classes roughly corresponding to their attributes. Such preliminary assistance in selecting their vocations would be of great value, for it would determine whether they possessed the necessary qualifications or would be likely to develop them.

Vocational guidance is only a few years old. It offers a new outlook to parents and teachers, and makes them of necessity partners in the great scientific enterprise of finding careers. Its influence must extend to home and school, and is likely, in the near future, to greatly modify present methods of determining the capacities of children. It is a matter of studying their mental equipments and aptitudes with the sole object of fitting them, to the great advantage of all concerned, into the activities of life. The methods that have been in vogue have undoubtedly resulted in great wastage. For a young person to pass by a system of trial and error through a succession of jobs until, by good luck more than by anything else, the right vocation is found, is thoroughly unsatisfactory. Vocational unfitness is a prime cause of industrial unrest.

7. VOCATIONAL SELECTION

Vocational selection is simply any process of selecting from a group of applicants those most suited for existing

vacancies. It has been explained in the preceding paragraph that vocational guidance aims at finding the best job for a particular worker; vocational selection tries to discover the best worker for a particular job. The former rests on the assumption that of all occupations some are better suited than others to the mentality or physique of any one worker; the latter assumes that some workmen are better fitted than others to any one job. Nobody can deny the truth of these assumptions: the only problem to be solved is the best way of following them in practice. Both are the subject of contemporary thought and research.

Many important industrial enterprises have organized their own particular system of selecting from a number of applicants those candidates who appear to be most suited to vacant jobs. Sometimes this takes the form of a simple test or trial. Girls required for neatly packing boxes of sweetmeats might be tested by their skill in fitting quickly certain specially shaped pieces of wood into a number of holes of similar miscellaneous shapes and sizes, the whole process not being unlike solving a jig-saw puzzle. This is an extremely simple example of vocational selection, but it illustrates a principle which is being extended to cover all kinds of industrial work. In engineering works of any magnitude new operators are often placed in charge of a special foreman, and given trial jobs to test their capability, before they are put on production in the workshops.

8. FACTORY HYGIENE

All those engaged in industry spend the most active part of their lives in factories or mines, and, naturally, general hygienic conditions have assumed great impor-

tance, and have been receiving closer supervision by the factory inspectors. It is now thoroughly realized that very important effects are exerted on health and well-being by the efficiency of ordinary sanitary arrangements, and the correctness of heating, lighting, and ventilation. The Home Office is steadily extending its statutory control over these conditions. In addition, there are special risks associated with dangerous trades, and other particular processes which form a connected subject. Minimum requirements are governed by the Factory and Workshops Acts.

The lighting of factories has greatly improved now that electricity can be adapted in so many ways. The essentials of good artificial lighting are :

(*a*) Adequacy.

(*b*) A reasonable degree of constancy and uniformity of illumination over the area of work.

(*c*) The placing or shading of lights so that light from them does not fall directly on the eyes of the operator when engaged on his work, or when looking horizontally across the workshop.

(*d*) The placing of lights so as to avoid the casting of extraneous shadows on the work.

The temperature in workrooms is another important matter, and it should differ according to the nature of the work done. The following is a satisfactory range of suitable temperature :

Sedentary work	58–66 Fahr.
Light work at machines . .	50–61 ,,
Heavy labour at machines. .	46–51 ,,
Heavy manual labour. . .	44–48 ,,

Both lighting and heating requirements are now incorporated into the official government regulations controlling factories.

The humidity of the atmosphere is another condition of importance to the health and comfort of workers. In weaving cotton and other textiles it is necessary to have a warm and moist atmosphere, so steam or running water is often introduced into the building. Artificial humidification sometimes causes bronchitis. Factory control has been introduced, and insistence is now placed on proper ventilation and certain maximum readings for the hygrometer temperatures, whose wet bulb should read about 70°. Excessive dryness is also unsatisfactory, and some methods of heating workshops give rise to such a condition.

9. MEDICAL SUPERVISION

In addition to hygiene, the attention of factory inspectors is especially directed to medical supervision. This subject is intimately connected with the Factory, the Employers' Liability, and the Workmen's Compensation Acts. The Home Office requires every establishment employing over 500 workers to have installed a special ambulance room. Often a thoroughly well-equipped building is designed, providing a waiting-room, a surgery, a rest room, a nurse's room, and, when men and women are both employed, two distinct ambulance rooms. There may be a permanent doctor on the staff, or a visiting doctor, and there will be necessary nurses and attendants.

An emergency room is advisable in every factory, even if only of moderate size, which would contain a cot-bed, a stretcher, a suitable medicine cabinet, and portable first-aid appliances which can be taken to any part of the works. The supervising doctor will specify exactly what should be obtained. In every workshop,

however small, first-aid equipment is required to be kept. The contents of the small cases suited for factories employing under fifty persons, and the larger cases for larger establishments, are all specified in official regulations and are well known. These modest medical requirements are often of the greatest value. Serious results may arise from quite trivial causes. The ease with which elementary first-aid treatment can be given should never allow small accidents to result in serious injury or prolonged incapacitation.

So general is this view becoming that " safety first " ideas are now very popular. The more the problem of accidents in factories is studied, the more evident does the need for a wide adoption of safety first principles become. There is still far too large a number of serious and avoidable accidents, and if a real inroad is to be made upon these, all those engaged in industry must seek in every way to prevent them at the source.

It is the experience of the Factory Department of the Home Office that only a minority of the accidents reported to the inspectors are preventable by physical safeguards ; of the rest the great majority are attributable to human failings, and can be prevented only if employers will make " safety first " an integral part of management, and workers will educate themselves to carry on their work with a proper consideration for the safety not only of themselves, but (more important perhaps) of their fellow-workers.

10. NATIONAL HEALTH AND PENSIONS INSURANCE

Compulsory insurance against sickness commenced in the United Kingdom in July 1912, the National Act having been passed in the preceding December. This

orders that all employed persons between the ages of 16 and 70, whose remuneration, unless they are engaged in manual labour, does not exceed £250 per annum, must be insured. Regarding manual workers there is no limit to the earned income. The pensions section was added in 1926.

The contribution for each male worker is 1*s.* 6*d.* and for each female 1*s.* 1*d.* per week, of which the employer pays 9*d.* and 7*d.* respectively; but under certain circumstances the latter's share may be increased to 10*d.* and 1*s.* 1½*d.* for men, and 8*d.* or 11*d.* for women, depending on their daily remuneration. Payment is made by deducting the worker's share from wages payable, and the employer purchases stamps at a post office for the total weekly contributions, and fixes them to a special card. This is a simple clerical duty and involves only a very small extra charge on production. The insurance scheme is administered by the Ministry of Health. Financially it has been completely successful, which is a contrast to the unemployment insurance scheme. The principle of health insurance is unexceptionable, but the pensions section has met with some criticism.

The benefits which all insured persons are entitled to receive are as follows:

(*a*) Medical Benefit—*i.e.* treatment by a doctor and the supply of medicine.

(*b*) Sickness Benefit, after 104 contributions have been paid, amounting to 15*s.* a week for a man, and 12*s.* a week for a woman, and lasting for not more than 26 weeks, when it is succeeded by

(*c*) Disablement Benefit, being 9*s.* a week for men and 7*s.* 6*d.* a week for women for the remainder of the illness.

(*d*) Maternity Benefit of 40*s*. payable after 42 weekly contributions.

(*e*) Widows' Pensions, Children's Allowances, Orphans' Pensions, and Old Age Pensions, under defined conditions.

Chapter XVI

MODERN INDUSTRY

I. THE FACTORY SYSTEM

THE essential reason why the factory system has prospered and grown to such large dimensions, sweeping away handicraft, guild, and domestic systems, is quite a simple one. Productive labour thus organized can make articles of commerce more efficiently and at less cost than can isolated labour. As soon as an article is cheapened the demand increases, not proportionately, but according to the varying nature of demand itself. This is a matter often discussed from a theoretical aspect in books on Political Economy. The increase set up in demand enables still further progress to be made in factory production.

By the demand increasing disproportionately to the reduction in price is meant that, if goods are greatly wanted, but owing to price maintenance only a limited number can be purchased, then, as soon as the price is reduced by, say, 10 per cent., the demand will often be stimulated by much more than 10 per cent. It may, for instance, be doubled, because so many more people can buy it. The general rule is that the cheaper the article the greater the demand, and the greater the demand becomes the less it costs, because of the possibilities of increased production.

In this way the factory system has enormously improved the general standard of life. Those who doubt this, if there be such people, should spend a period in some remote country where neither the factory system nor its products have yet penetrated. These regions become more and more difficult to find, but perhaps parts of Siberia and the remote central provinces of China remain sufficiently unaffected by the material progress of western civilization to serve as instances. The conditions of those of their inhabitants who correspond to a working class is incredibly unfortunate. Their toil is unremitting; they live in perpetual squalor; the average length of their lives is shortened by at least one-third through lack of necessary nourishment; medicine is unknown and the death rate excessively high, which itself is a source of misery; starvation is rampant, often through sheer lack of means of equalizing a bad harvest by transporting food from other regions. Yet those people are by no means uncivilized—it merely happens that they are living in a pre-industrial revolution age. The French and other nations lived through similar conditions less than two hundred years ago.

2. CAPITAL AND LABOUR IN THE FACTORY SYSTEM

The factory system is enabled to flourish because it is supported by capital. It is important not to fall into the error that capital ever invented, or to-day causes the factory system to exist. The only reason why it exists is that the people of the world demand great quantities of goods, which can only be produced by the modern factory system. Those who possess capital are generally prepared to provide factories and equipment wherever there is an obvious demand for them, on con-

dition they are paid back in dividends or profits. If the demand did not exist the services of capital would not be required, nor would the services of workers. The cause being there, capital merely comes in as one of the effects. This distinction seems so self-apparent that it is surprising so many fallacies exist about it.

Some of the fundamental mistakes made by writers like Karl Marx and Engels and others, who attack what they term Capitalism, arise from a confusion of thought. They appear incapable of distinguishing between machine industry, which is modern industry, and factory labour, which industry employs. The labour did not give rise to the machine industry. Indeed it is well known that in misguided moments the workers have often tried to prevent machinery being utilized, although they have always failed to hold back progress for long. Machines and power were introduced into industry. The world wanted the new developments very badly, and industry progressed apace. Capital has helped it along, and more and more workers have been required. The population has increased rapidly because of the available means of livelihood—even since 1918 no less than three million more workers have been absorbed into British Industry. The sequence of cause and effect is perfectly clear.

The factory system enables packed industrial populations to live who, without it, could never have come into existence at all, and were it to languish and cease to operate, would have to emigrate or suffer extermination. By it they have been granted a possibility to live in an orderly way, to enjoy regular employment, improved health standards, longer lives, higher real wages, and a standard of living which was never realized before and which steadily improves. It has given to each succeeding generation innumerable advantages beyond the

dreams of its fathers. It has enabled an intellectual revolution to follow on the heels of the industrial revolution. Like all human creations, the factory system has its disadvantages and imperfections. It is a duty to remedy these, but it is equally a necessity to preserve and improve a system essential to life in Great Britain.

3. THE FUNDAMENTAL INDUSTRIAL PRINCIPLES

Throughout the previous chapters many fundamental principles which govern industrial production have been referred to and explained, such as organization, co-ordination, co-operation, division of labour, mass production. Industry, whether carried on in small factories or the largest works, is governed by these principles. It is essential for all to work in harmony with and conscientiously obey them, for if violated, economic disaster must follow. It should not be difficult now to obtain a clear perception of their nature and the way they operate. First of all a broad classification divides them into two groups:

(1) Principles that depend on the qualities and characteristics of human nature.

(2) Principles which are impersonal; sometimes are termed "economic laws."

The first group of personal principles includes such human virtues as ability to manage men, a capacity for loyalty to colleagues and fellow-workers, a desire to spend life industriously, to practise scrupulous honesty, and so on.

The impersonal principles can be formulated as the results of past experience and research, and have been incorporated into economic theory. Six can be described:

(1) Division of labour.
(2) Co-operative effort.
(3) Scientific method.
(4) Embodying manual skill in tools.
(5) Embodying mental skill in machines.
(6) Protection of invention.

For a more detailed criticism and analysis of the term " economic law " it would be well to refer to text-books which deal with the theory of economics. It is sufficient to say here that economic laws are not laws in the usual sense of the term, but generalizations about economic practice and its known consequences.

4. PERSONAL PRINCIPLES

To deal first with the natural human qualities, it must be realized thoroughly that industry does not consist of rows of machines, but groups of men in action, just as warfare is not so many guns and ships, but men using them. Industry is simply a normal human activity. In all human activities the practice of certain virtues enables success to be achieved. Neither a solitary man nor many working together can get work done except by being industrious. Men working together under a leader must all, leader and men, be loyal to each other. Some are more suited to play the part of leader, others to be subordinates. Personality has something to do with that. It must, however, be realized that a man who is a leader of certain men, must in turn be subordinate to many others.

In industry the consumer is the ultimate force, not the employer. In modern industry carried on under fierce competition there has been a growing tendency for the heads of industrial units to get into closer contact

with consumers, and, by sheer force of circumstance, to neglect personal leadership inside their own units. It is said that the direction as well as the ownership of industry has become more and more impersonal. Workmen often do not know their own employers when they see them. This is said to be a fruitful cause of misunderstanding and labour unrest—a more than likely contingency. It proves the incessant demand for personality in the organizing of human effort.

Behind personality comes the importance of method. Only a masterful control of scientific method will enable a man to rise to any position under present conditions, for these are complex and change continually. Industrial methods must be systematic and of great virility if they are to be successful. Initiative is necessary, by which is meant the ability to think and do new things. As external conditions change, so must quick adjustments be made. Difficulties must be faced with courage ; all great industrial leaders have been courageous men. They have dared things, and their energy has enabled them to succeed. They have, in fact, possessed unlimited initiative, courage, and energy—a most valuable trio of personal qualities.

5. DIVISON OF LABOUR, CO-OPERATIVE EFFORT, AND SCIENTIFIC METHOD

The division of labour is the best known impersonal and economic principle of industrial production. It was first described by Adam Smith about one hundred and fifty years ago, but since then modern factory methods have carried the principle to an extreme degree. Its function is purely a matter of cheapening the cost of production. It is not confined to manual labour, but is

actively applied to mental processes. Practice of the former is materially aided by use of tools, and the latter by records and data embodying previous experience.

Co-operative effort arises from the increasing division of labour. It becomes more important to co-ordinate the divisions and enable them to co-operate. The way this is done by the factory staff under the control of the general manager has been already described. Usually co-ordination is compulsorily enforced, but efforts have also been directed to bring about co-operation on a voluntary basis. It has not been very successful in productive industries, but in retail business co-operative societies owning warehouses and stores are well established. This, however, is not quite the same thing in principle as the co-operation practised on all industrial plants.

Scientific method is the procedure by which precise knowledge is acquired. It is a matter of reducing various recorded experiences to a basis of regularly established law. On past experience are based the methods used in organizing and administering a factory. Manual processes, as occur in production both on machines and in handicraft, as well as the mental processes of planning, estimating, designing, rate fixing, and others, are all based on previous experience reduced to scientific method.

6. TOOLS WHICH REPLACE MANUAL SKILL

One of the unique gifts men possess is that of making tools. Flint tool-making was probably an organized industry in Britain ten or twenty thousand years ago, or perhaps much more. This can be the only explanation of the great dumps of flint chips still existing in Norfolk and elsewhere. There is no doubt it enjoyed a flourishing export trade. It may have been the first example

in these islands of industrial production on a large scale.

Tools, first of flint, then of bronze, then iron, and now steel, all embody the principle of the transfer of manual skill. They enable men to supplement their skill and strength. To go back to the flint industry, the workers sought for their raw material by mining in chalk. There were shafts and underground workings just as in a coal mine to-day. They required a tool to help their fingers pick out the earth and chalk in the workings, and they utilized deer's antlers tied to sticks as pickaxes—an obvious transference of hand power. To-day a steel-headed pick is the same tool made of better materials.

This principle has been developed in modern industry to a surprising extent. The jigs and fixtures in an engineering workshop are all similar in principle. To make them a man with highly-trained manual skill, known as a toolmaker, transfers his skill to certain appliances so that ordinary unskilled labour may be able, with their aid, to produce. Modern mass-production methods are based on the use of tools of this character, so that the workers can manufacture highly accurate interchangeable units without possessing sufficient manual skill to make them without such aid.

7. TOOLS WHICH REPLACE MENTAL WORK

The much greater acceleration in production processes of recent times has been obtained by a further development of tool-making. With the best of pickaxes, or jigs and fixtures, the worker still has to carry out the work. The tool only helps him to do it. Now there are available many tools or machines which imitate the movements of the worker and so do the work automatically.

In place of pickaxes, power-driven coal cutters are used in collieries. There is the reaper and self-binder used in the harvest fields. The Fourdrinier paper-making machine is an excellent example of this transference of routine mental work to the machine. It is, of course, not intended to suggest that any of these machines possess intelligence. They do, however, carry out operations which otherwise require joint mental and manual effort. Many of them indeed do work which could never be done by unaided human power. Industrial production now very largely comes from such machinery.

8. THE PROTECTION OF MECHANICAL INVENTION

The transference of both manual and mental skill into tools and appliances is largely comprised under the term invention. The greatest progress in industrial production results from continual invention and improvement. To encourage the full use of inventive skill all the Governments of the world have agreed upon international protection and the granting of valid patents whereby an inventor is assured to a large extent of benefit from his work.

How great are the results from labour-saving and production-aiding appliances will be gathered best from a brief list of recent improvements, and the claims made for them, all of which have been substantiated in actual practice.

(*a*) A casting machine for running iron from a blast furnace into pigs enabled seven men to replace sixty.

(*b*) A crane fitted with an electrical magnet used for unloading iron enabled two men to do what previously required 128.

(*c*) A guillotine machine used for cutting cloth for clothing enabled one girl to produce more than twenty-five times what she had previously accomplished by hand.

(*d*) Automatic conveyors for unloading coal at piers have shown that twelve men could do what previously had required 150 men.

(*e*) For the whole wheat crop of the world it is considered that about seven million days' work is required for its harvesting now that reapers and self-binders and other agricultural machines are used. If these had not been invented it would require 130 million days' labour.

All this labour is, of course, not released to unemployment. It turns from the work where it is no longer required to fresh tasks awaiting it, and the dislocation is a temporary affair. Most of the above inventions are new compared with those made during the years allotted to the industrial revolution, but there are many more still newer, such as cinematography, wireless, and other electrical developments. These, together, in the British Isles pay yearly some hundreds of millions in wages. Invention indeed is one of the greatest forces behind industrial production, and the principle of affording state protection for patentees is not the least of the factors which ensure continual progress.

INDEX

Absenteeism, 137.
Accountant, Works, 43.
Acts of Parliament, 72, 74, 77, 113, 118, 129, 130, 149; Employers' Liability Act, 133; Factory and Workshops Acts, 214; National Insurance, 216; Trades Disputes Act, 149; Trade Union Acts, 149; Workmen's Compensation Act, 133.
Administration of Industry, 165.
Allowances, Family, 123. *See* Family Allowances.
Amalgamated Engineering Union, 142.
Apprentices, 77; Duties and Privileges, 79; Indentures, 78; Training, 81; Welfare of, 208.
Apprenticeship, National Institute of, 78.
Arbitration, 140.

Boulton and Watt, 68.
Buyer, The Head. *See* Purchasing.

Ca' Canny, 111, 137; Reasons for, 139; The Economic Fallacy of, 138.
Capital, 163, 220; Fresh Capital every Year, 162; Investment per Worker, 163; Joint Stock, 161.
Carnegie, Andrew, 168.
Casson, H. N., 195.
Collective Action, 145. *See* also Stoppages, Strikes, Lockouts.
Collective Bonus Systems, 109; Priestman Bonus System, 110.
Collectivism, 145.
Continuous Manufacturing, 60.
Co-operation in Factories, 190; Co-operative Effort, 224.
Co-partnership, 111; Gas Company System, 113; In the Coal Industry, 115; Lever Brothers' System, 114; New Zealand Legislation, 118; Share Holding by Employees, 118.

Demarcation, 25.
Designing, 17; The Chief Designer, 42.
Directors, 160; Duties of, 165; Managing Director, 167.
Division of Labour, 224.
Domestic System, 64, 65; In Lancashire, 73.

Edward III. and Early Industry, 63.
Employers, 158; Federations of, 162.
Employers' Liability, 133.
Engels, 221.

Factories: A Motor Car Factory, 38; A Typical Factory, 38; Abuses in, 73; First Modern Factory in England, 67; General Characteristics of, 50; Location of, 50.

Factory Hygiene, 213. *See* Hygiene.
Factory System, 62, 67, 219; Abroad, 69; Capital and Labour, 220; Early History of, 62.
Family Allowances, 123; In France, 124.
Fatigue, Industrial, 210; Institute of Industrial Psychology, 210; Research Board, 210.
Feudal System, 62.
Flint Tool-making, 225.
Foremen, 45; Duties of, 173, 193; Influence on Workers, 194; Information for, 192; Rules for, 195.
Friendly Societies, 144.
Friendly Society of Iron Founders, 142.
Fuel and Power Supplies, 53; Horse-power per Worker in America, 61; Horse-power per Worker in Sheffield, 61; Relative Importance of, 54.

GILBRETH, DR. F. B., 182, 193.
Guilds, Craft, 62, 142, 145.

HORSE-POWER: Provision in American Factories, 61; Provision in Sheffield Factories, 61.
Hygiene, Factory, 213; Heating of Factories, 214; Humidity in Factories, 215; Lighting of Factories, 214; Minimum Requirements, 214.

INDIVIDUALISM, 144.
Industrial Administration, 165. *See* Administration.
Industrial Court, 140.
Industrial Fatigue. *See* Fatigue.
Industrial Insurance. *See* Insurance.
Industrial Insurance Societies, 144.
Industrial Organization, 170. *See* Organization of Industry.
Industrial Principles. *See* Principles of Industrial Production.
Industrial Production, 45. *See* Production, Industrial.
Industrial Products, Types of, 15; A Motor Car, 15, 38; Artificial Silk, 28; A Ship, 21; Calcium Carbide, 45; Flint Tools, 225; Locomotives, 45; Newspapers, 45; Paper, 35; Sugar, 31; Wool, 45.
Industrial Research, 204. *See* Research.
Industrial Revolution, 67, 71; Advance of, 68; Connection with Trade Unionism, 145; Relation to Individualism, 145; Results of, 69, 71; Toynbee's name, 68.
Industry: Location of, 50, 51; The Earliest, 225.
Inspection Department, 45, 196; Inspection Organization Chart, 197; Testing a Dimension, 199.
Institute of Industrial Psychology, 210.
Instruction Sheets, 187.
Insurance, Industrial: Employers' Liability and Workmen's Compensation, 133; National Health and Pensions, 216; Unemployment, 135.
Intermittent Manufacturing, 60.
Invention, Protection of, 227.

LABOUR: Agreements about Working Hours, 128; Factory Acts, 131; Hours of, 126; Supply of, 52.
League of Nations, 75.
Leroux, Pierre, 146.

Location of Industries, 50; Economic Factors governing, 51.
Lockouts. *See* under Stoppages.

Management, 167: Andrew Carnegie on, 168; The General Manager, 39; The Works Manager, 41.
Manorial System, 62.
Markets, 56.
Marx, Karl, 221.
Mass Production, 20.
Materials. *See* Raw Materials.
Mechanical Invention, 227; Importance in Industry, 31, 32, 35, 37.
Medical Supervision, 215.
More, Sir Thomas, 72.
Motion Studies, 182.

National Union of Railwaymen, 143.

Organization of Industry, 170; Dr. F. B. Gilbreth on, 182; Functional Organization, 175; F. W. Taylor on, 178; Line and Staff Organization, 177; Simple Line Organization, 171.

Parliament. *See* Acts of Parliament.
Piece Work: Advantages and Disadvantages of, 99; Payment by, 98.
Planning Department, 44, 184; Duties of, 186; Instruction Sheets, 187.
Premium Bonus System, 103; Halsey or Weir, 104; Rowan, 106.
Principles of Industrial Production, 222; Co-operative Effort, 224; Division of Labour, 224; Impersonal Principles, 224; Mechanical Invention, 227; Personal Principles, 223; Scientific Method, 224; Tools to replace Manual Skill, 225; Tools to replace Mental Skill, 226.
Production Department, 44, 191.
Production, Industrial: Continuous, 60; Final Stages of, 48; Intermittent, 60; Main Object of, 45; Methods of, 46.
Profit Sharing, 111; Opposition of Trade Unions, 112.
Progress Department, 44, 190.
Purchasing, 18; The Head Buyer, 42.

Radcliffe, William, 73.
Rate Fixing, 189.
Raw Materials, 18, 29, 56.
Research, 204; Government Aid for, 204; Industrial Fatigue, 210.
Restriction of Output, 137. *See* Ca' Canny.
Revolution, Industrial, 67. *See* Industrial Revolution.

Shareholders, 160; Cotton Trade, 159; Mining, 159; Railway, 158; Road Transport, 158; Shipping, 158.
Silk Hatters' Union, 142.
Socialism, 146.
Standardization, 46, 200.
Standards, 198.
Stoppages, 152; Development of, 154; Economic Loss from, 156; General Strike, 154.
Stores and Storekeeping, 43, 202; Theory of, 203; The Storekeeper, 43.
Strikes, 152. *See* under Stoppages.

Taylor, F. W., 178, 185, 189, 192.
Taylorism, 179. *See* F. W. Taylor.
Time and Motion Studies, 181, 189.
Toynbee, Arnold, 68.
Trade Boards, 140.
Trade Unionism, 146. *See* under Trade Unions.
Trade Unions, 142; Activities of, 149; Amalgamated Engineering Union, 142; Annual Income of, 143; Demarcation with, 25; Disbursements of, 143; Friendly Society of Ironfounders, 142; Legal Standing, 148; Management Expenses, 143; Methods of, 149; Motive of, 146; National Union of Railwaymen, 143; Policy of, 149; Silk Hatters' Union, 142; Subscriptions to, 143.
Transport, 38, 57.

Unemployment, 134; Benefits, 135; Insurance against, 135.
Vocational Guidance, 211.
Vocational Selection, 212.

Wages, 90; Calculation of, 91; Modern Systems of Calculating, 101; Money and Real Wages, 121; Past and Present compared, 119; Piece Work, 98; Relation to Profits and Losses, 92; The Wage System, 90; Time Rate, 96.
Watt, 68.
Welfare, 206; For Boys, 208; For Women and Girls, 209; Organization of, 207; Supervision, 206.
Whitley Councils, 140.
Workmen's Compensation, 133.
Workers, Industrial, 44; Apprentices (*see* separate heading); Compensation for, 133; Craftsmen, 84; Factory, 220; General Classification, 76; Improvers, 84; Labourers, 87; Semi-skilled, 85; Social Advancement of, 71; Social Independence of, 70; Training, 82.

PRINTED IN GREAT BRITAIN AT
THE PRESS OF THE PUBLISHERS

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Author Lee, Richard Henry Lovelock
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